

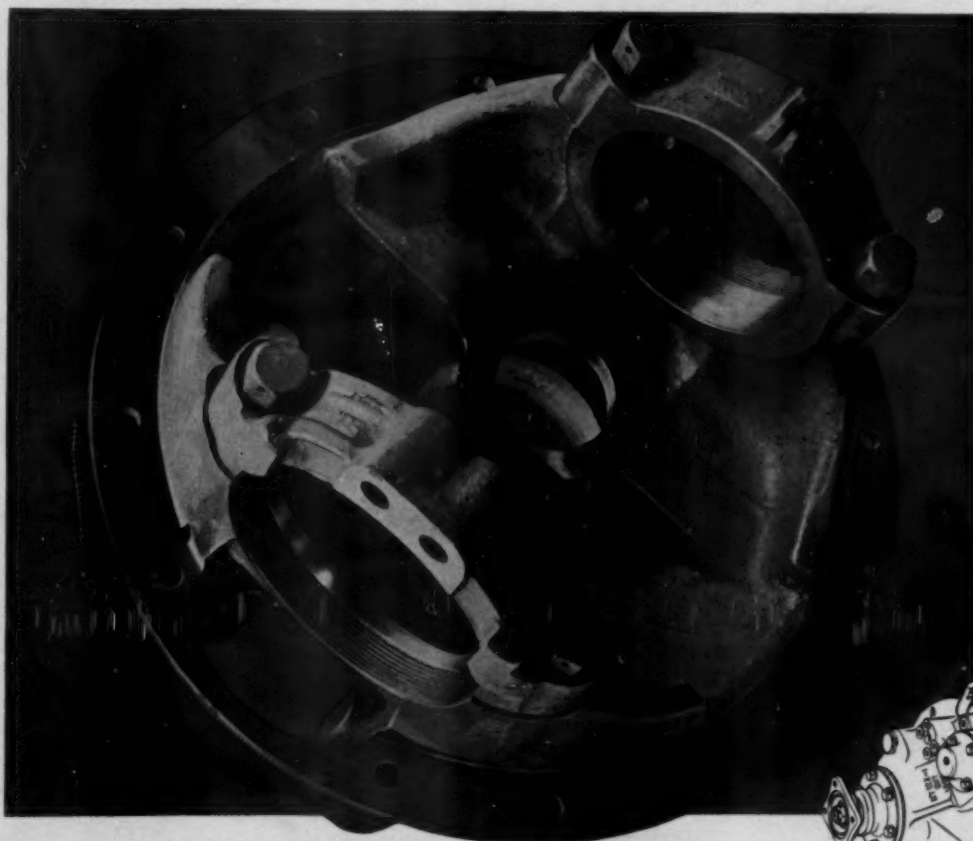
AUTOMOBILE ENGINEER

DESIGN · PRODUCTION · MATERIALS

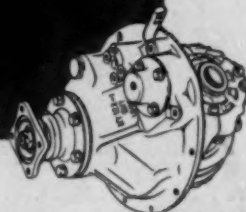
Vol. 48 No. 3

MARCH 1958

PRICE: 3s. 6d.



A
fine casting for
a commercial
vehicle
two-speed rear
axle.



LEY'S

MALLEABLE IRONS:

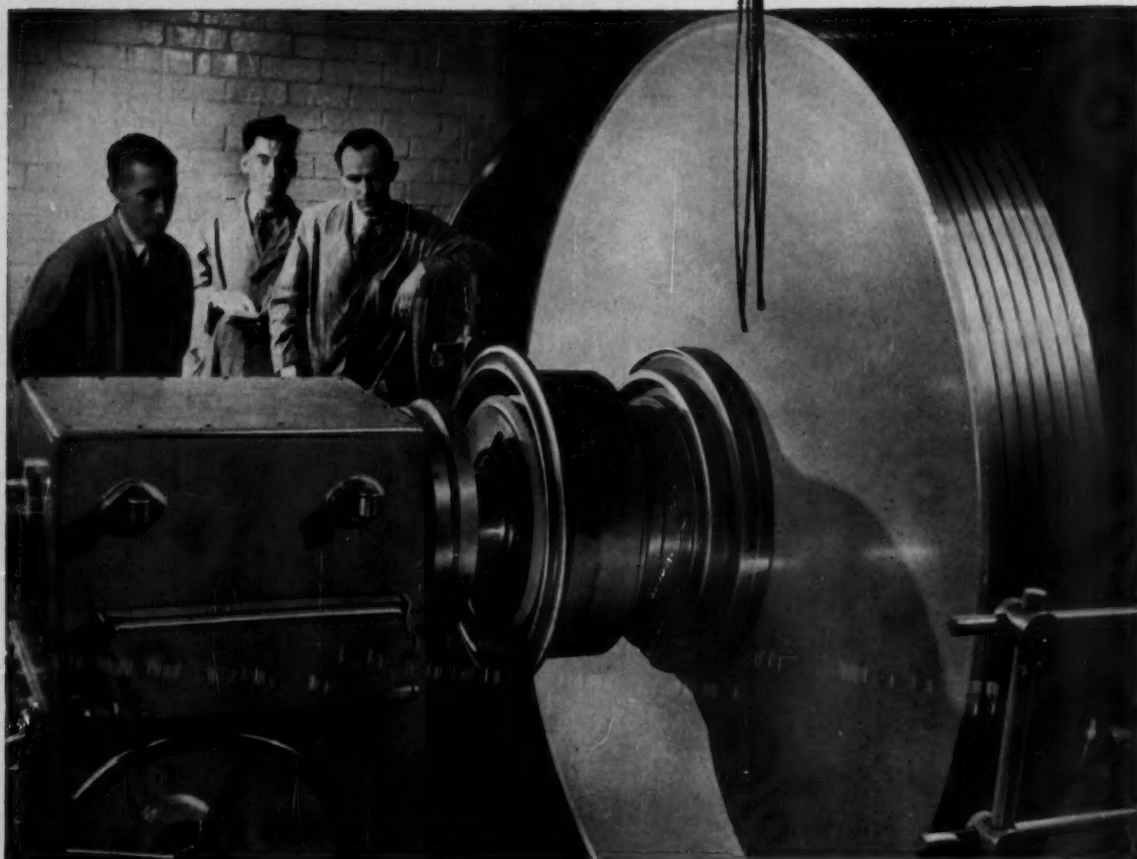
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LEY'S MALLEABLE CASTINGS COMPANY LIMITED, DERBY

Europe's
largest
malleable
producers

FULL STOP

*to twenty five
double decker buses!*



This Mk V Inertia Machine tests Mintex Brake liners under controlled conditions, for friction, fade and general performance. It subjects them to stresses greater than any met on actual service. The flywheels are brought up to a given speed, the brake is applied, and torque, brake drum surface temperature and stopping rate are recorded. The Mk V, one of the largest machines of its kind in the country, generates up to 18½ million ft/lb kinetic energy—equivalent to the energy absorbed in halting 25 double decker buses from a speed of 30 m.p.h. Together with many others similar machines in the B.B.A. laboratories it provides one of the reasons for the

long and consistent service that Mintex brake liners give. Research has always been the heart of our business. It continues today with greater emphasis than ever, making sure—and doubly sure—that

you can rely on
MINTEX

Mintex Brake and Clutch Liners are manufactured by British Belting & Asbestos Limited, Cleckheaton, Yorkshire, and are available from MINTEX Service Depots and Distributors throughout the country.



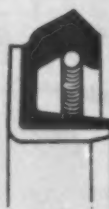
TYPE 11 P

The standard rotary shaft seal. Gives perfect sealing at high speeds and for long periods, with minimum frictional loss.



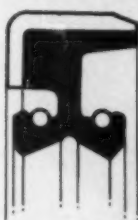
TYPE 11 P/B

As type 11 P but with the casing covered with rubber. Interchangeable with metal case seals.



TYPE 23 P

An external seal used when fitting conditions prevent the use of 11 P or 11 P/B seals.



TYPE 12 P

A rotary shaft seal used to separate two different fluids.



TYPE 13 P

Similar to type 12 P but without a spring on the second lip which serves as a dust excluder.



TYPE 31 P

A springless seal used as a wiper or dust excluder for rotating or reciprocating shafts.



NU-LIP RINGS

A special section ring which cannot twist. Superior to the O-ring for low and medium pressure non-static applications.



O-RINGS

A compact automatic seal for reciprocating and static applications over a wide range of temperatures and pressures. All British Standard sizes in stock.

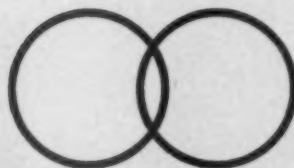


TYPE 7 P

A hydraulic and pneumatic seal used chiefly on reciprocating pistons or as a valve stem packing. Normally fitted in a groove.

PIONEER OILSEALS O-RINGS AND HYDRAULIC PACKINGS

Every fluid sealing application comes within the Pioneer range. Write NOW for the PIONEER OILSEAL LITERATURE. The PIONEER man is trained to solve your sealing problems on the spot. Call him in now.



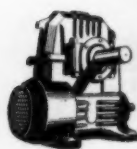
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A DIVISION OF J. H. FENNER & CO. LTD

Factory and Head Office: Cottontree Works, Colne, Lancs. Tel. Wycoller 471 (8 lines).



RIGHT UP OUR STREET! You don't find these air compressor rotors being turned out every day. We've not been making them long ourselves. But we've been thinking about them for ages. In working out a manufacturing technique, our long experience in the production of accurate worm gears was an invaluable asset. We have now developed an entirely new machine for the exclusive production of rotors and high lead angle pump screws. If you've got a job of this sort . . . you're right up our street!



Holroyd *rotors*

90 YEARS OF GEARS

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With acknowledgement to James Howden & Co., Ltd., Glasgow, for whom we made the above rotors.

CWC:188.

Alvis Leonides Engines



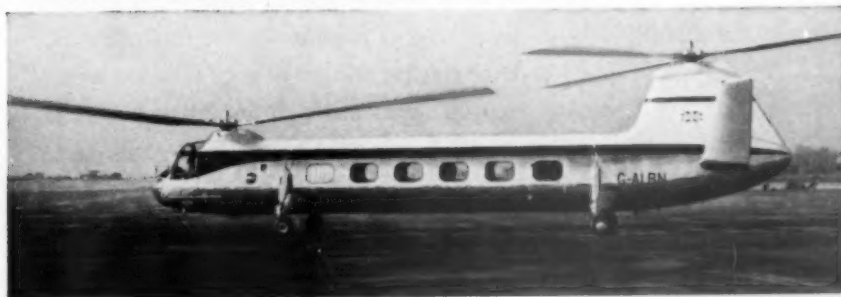
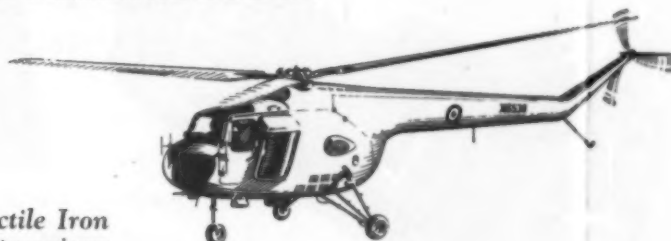
Use

HARPER CASTINGS

Harpers make the clutch plate castings used in Alvis Leonides engines, widely installed in helicopters. High strength, soundness and freedom from distortion are essential, as these castings provide the means by which the power is transmitted from the engine to the rotor blades.

Every casting is radiologically examined by Harpers to meet the requirements of the D.A.I.

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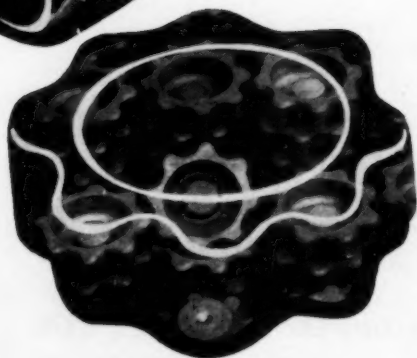
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FORGINGS • DROP FORGINGS • TOOL STEELS • HARDENED STEEL ROLLS

F51



FEATURES OF THE LOCKHEED DISC BRAKES

Long life of lining

The ample-sized friction pads of these extremely stable brakes give normal mileage without replacement, and the reserve of brake lining is clearly visible. Replacement of friction pads is simple, as shown, without disturbing any hydraulic connections.

The 'M' type brake in the photo has pads $\frac{3}{8}$ in. thick and $5\frac{1}{2}$ sq. in. area.


The 'H' type brake shown in the blue-print has pads $\frac{1}{2}$ in. thick and $7\frac{1}{4}$ sq. in. area.

Many other features contribute to safety and durability.

LOCKHEED

Registered Trade Mark : LOCKHEED

AUTOMOTIVE PRODUCTS COMPANY LIMITED
LEAMINGTON SPA, WARWICKSHIRE, ENGLAND



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CLUTCHES, WE ARE
TRANSMITTED THE
FERGUSON-SYSTEM
BY SIR EDMUND
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CLUTCHES WHICH
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REGD.
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POWER IN THE
TRACTORS USED
HILLARY AND HIS
ACHIEVEMENT

SOME OF THE STANDARD
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W U O T T O N

TWO STAGE



These 'MICRONIC' 2-STAGE DIESEL FUEL FILTERS are TWO FILTERS IN ONE. Two filter elements, in separate bowls, are connected to a common head, thus eliminating complicated pipe work. These 2-stage filters are available in two types, as follows:

METAL & 'MICRONIC': In this type, as illustrated, a metal edge element of .002" spacing is used as a primary filter to prevent the larger particles of dirt from reaching the extra fine 'Micronic' second-stage element. The life of the 'Micronic' element is thus greatly increased, and less maintenance is required.

DOUBLE 'MICRONIC': 'Micronic' elements are used in both stages; the second one being sealed to discourage unnecessary interference. This arrangement is most helpful where unskilled labour is employed as it eliminates the possibility of damage being caused by dirt introduced during element changes.

These filters are available for flow rates up to 10 G.P.H.

AUTOMOTIVE PRODUCTS COMPANY LTD., LEAMINGTON SPA, WARWICKSHIRE
ORIGINATORS OF PAPER FILTER ELEMENTS

PUR-LATOR

Registered Trade Marks:
Purolator, 'Micronic'

'MICRONIC' LUBRICATING OIL, FUEL AND AIR FILTERS



Felt washers and felt seals? Felt for anti-vibration bases, for buffing rollers, cushionings and filters? Those are **some** of the ways you can use Bury Felts. They can be die-cut, chiselled, punched, machined, and even ground. Bury Felts are felts made specially for industry; many types and textures to meet your needs exactly.

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... and the Belleville makes it possible ...!

The largest capacity spring balance in the world. This instrument was made to weigh giant steel castings and is graduated up to 200 tons with 1 ton sub-divisions. It is approved by the Board of Trade for "Trade" purposes, where the requirement is that the machine must be accurate to within a quarter of its smallest sub-division.

Two Belleville washers, in this instance opposed to each other, supply the spring resistant. Their total movement under full load of 200 tons is never more than $\frac{1}{16}$ of an inch.



SALTER...
...always a spring ahead!

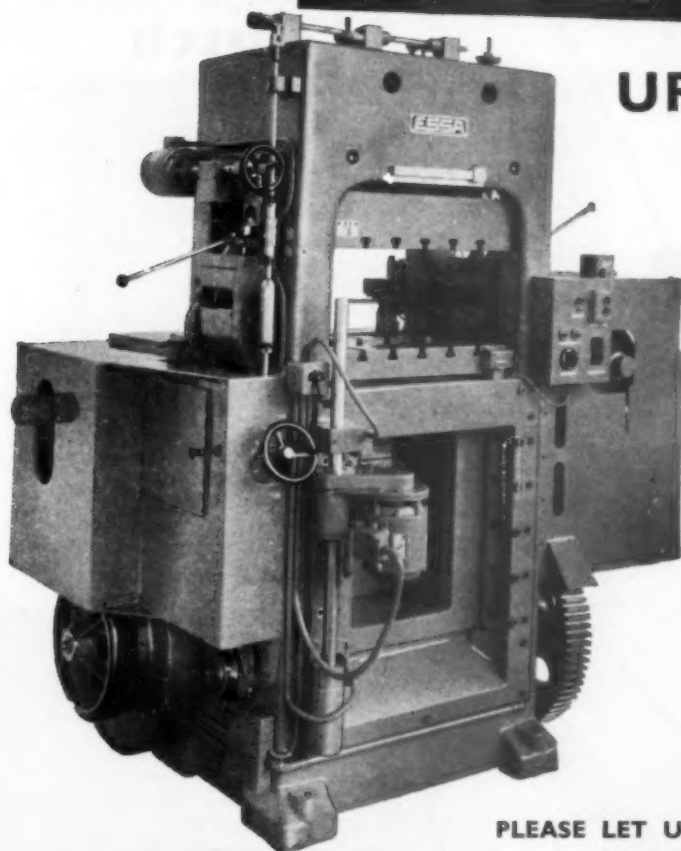
- ★ When resistance to load or thrust is beyond the capacity of helical springs,
- ★ When take-up of shock or sustained load must be restricted to very slight movement,
- ★ When many tons of dead load must be sustained plus intermittent shock or live load . .

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from the bottom upwards?*

ESSA



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**GIVE 7 TO 10 TIMES NORMAL
TOOL LIFE—**

**PLUS GREATLY INCREASED
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This precise and rugged Swiss-built machine gives greatly extended tool life up to, invariably seven to ten times that obtained from any other type of press by virtue of its design whereby vertical backlash is entirely eliminated; this means that the punches can be set so that they never enter the die. The machine shown is a double crank type equipped with double roll feed, strip end shear, scrap shear, and automatic stopping device. There is a full range available from 6 to 240 tons, single and double eccentric.

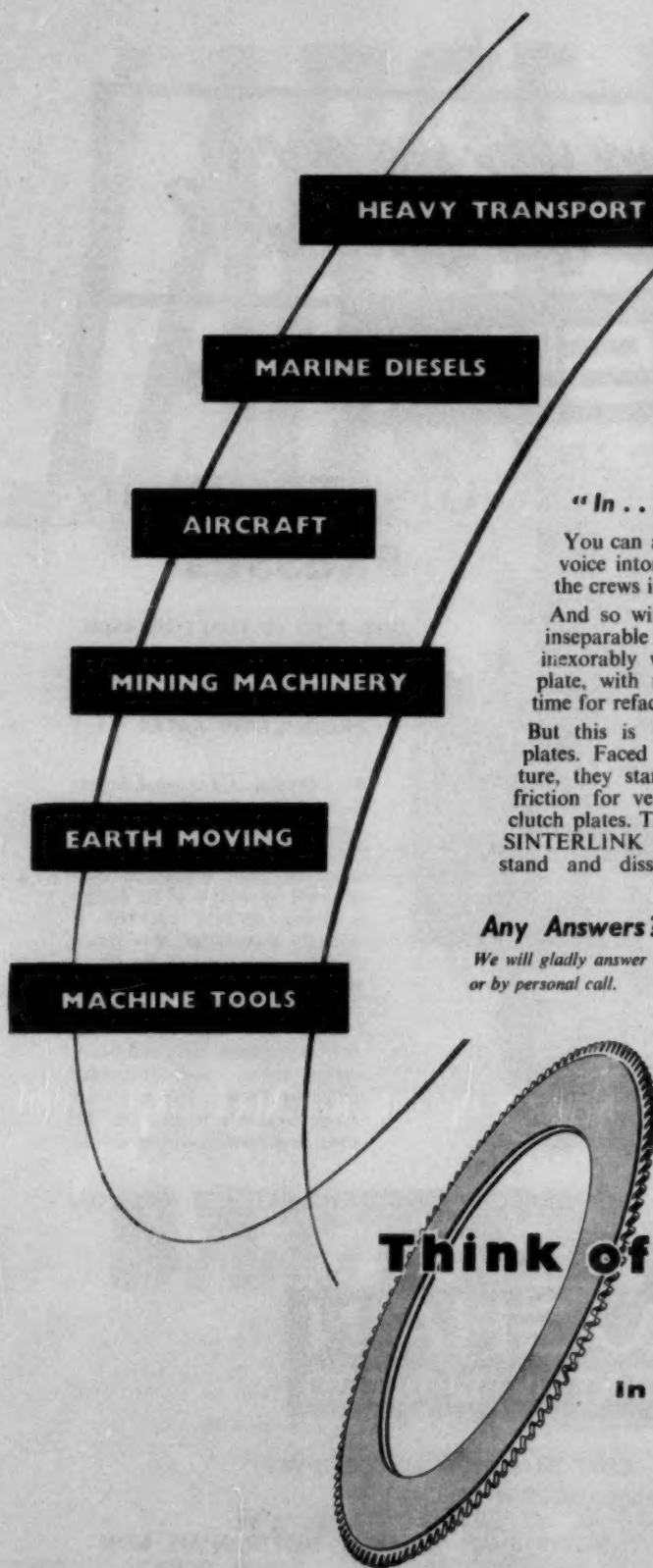
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Rainbow



Think of the clutch

"In out! In out!"

You can almost hear the Boat Race commentator's voice intoning the repetitive action that wears out the crews in some twenty minutes.

And so with clutch plates. The punishing friction inseparable from repeated engagements of the clutch inexorably wears out the normal type of clutch plate, with regrettable speed. Result — costly idle time for refacing or replacement.

But this is not so with SINTERLINK clutch plates. Faced with sintered metal of cellular structure, they stand up to a tremendous amount of friction for very much longer than conventional clutch plates. The exceptional resistance to wear of SINTERLINK and its remarkable ability to withstand and dissipate heat are the explanation.

Any Answers?

We will gladly answer any questions either by correspondence or by personal call.

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*Low Rate of Wear—Smooth Operation—
Stability—Absence of Fade—
High Thermal Conductivity.*

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**the final factor
in power transmission**

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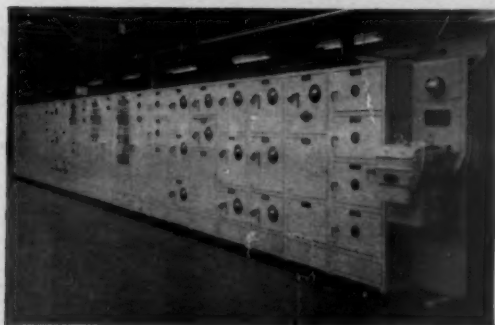
Igranic use

***AMP**

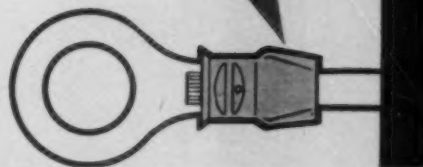
solderless wiring devices



Close-up of Control Panel sub-assembly, illustrating the use of Pre-Insulated Diamond Grip Tongue Terminals



Automation Control Panel built by Igranic Electric Company Limited for the Ford Motor Company Limited, Dagenham



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▲ RELIABLE PERFORMANCE

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AP-78



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multi-purpose induction heater

Ideal for production runs of varied components, the Birlec multi-purpose induction heater is a versatile machine that can perform in quick succession a wide range of single shot or progressive heating operations including hardening, brazing and soldering. It has a free-station work head that can be tooled for a number of varied jobs, whilst inductors can be interchanged readily to accept the different components. This ingenious machine can add greater flexibility to your production programme, speed output and reduce manufacturing costs.

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General type
(triangular flange)



Pedestal assembly



Pedestal mounting



Frustacon type



FN type



Instrument type
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Instrument type (square flange)

MOUNTINGS by

SILENTBLOC



Ring-stud
mounting



Bonded stud
mounting

VIBRATION-FREE

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Pioneers of Rubber in Engineering



The world is
turning increasingly to
R&M bearings



I gather Ransome & Marles have a substantial export trade?

Yes. Business overseas has been done for many years

through agents and subsidiary companies. Among our biggest customers are many of the newly industrialised countries in Africa and the Far East—countries which are now equipping themselves with machinery at an enormous rate. We also export our bearings to the established industrial areas—to Europe and North America—where our products enjoy a long record of first-class service.

You have, of course, a worldwide network of agents to support this export trade?

We have indeed. Something like eighty agency offices throughout the world. We are concerned, mainly, with providing an unrivalled on-the-spot service for overseas industry. Firstly, we produce bearings that will stand up to arduous conditions of work in every climate. Secondly, local users are thoroughly informed about all the factors affecting the actual running of the bearings. Thirdly, the purchaser is safeguarded with after-sales service. These are our obligations to the foreign manufacturer. I think it is fair to say that we meet them very successfully, because we are constantly expanding our export business and shall continue to do so in the future.

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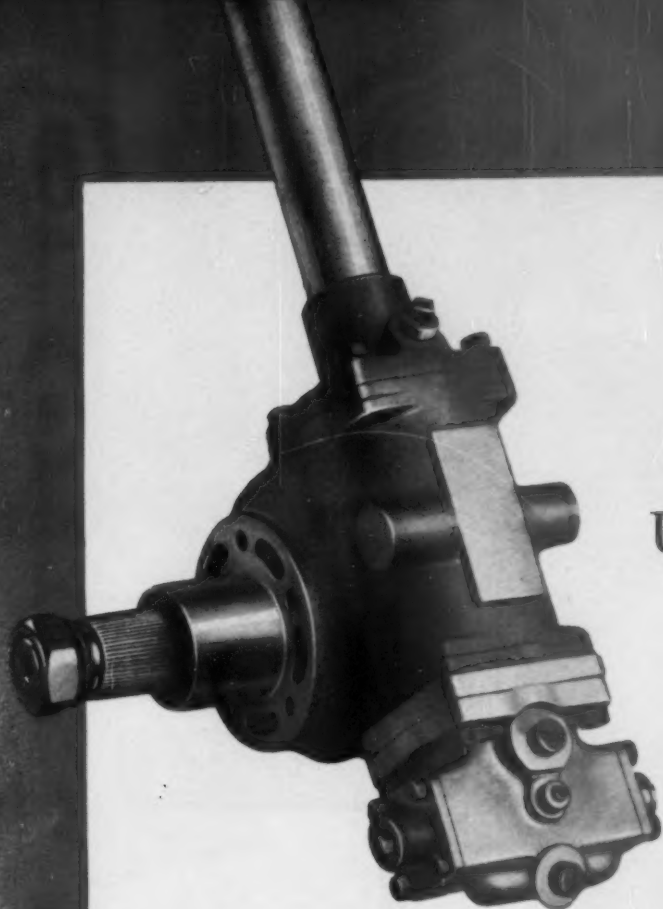


Emergency is the test of real efficiency

All the road safety precautions in the world cannot prevent an accident in a situation like this—but good brakes can! Ensure that *your* vehicle is equipped for all emergencies by fitting Clayton Dewandre braking equipment.

CLAYTON DEWANDRE CO. LTD.

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Sole proprietors of the Marles Steering Company Ltd.

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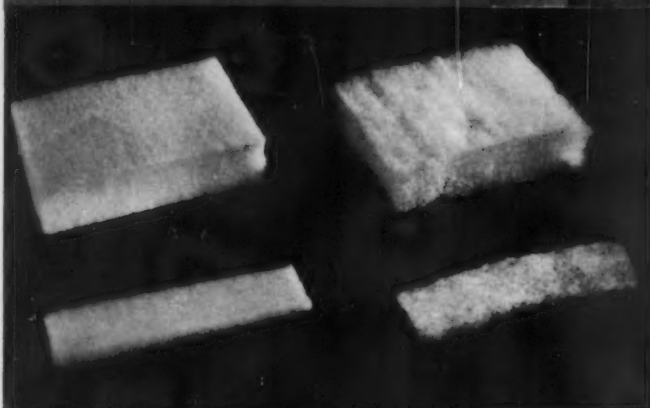
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Regd.

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—sheet or moulded, rigid or flexible,
white or coloured.

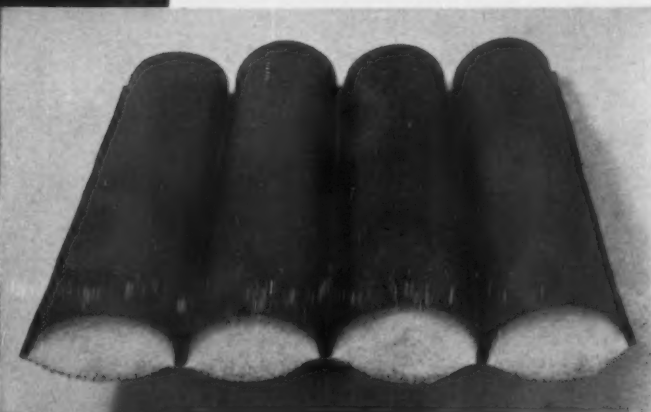


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FOR R.F. WELDING OF P.V.C.
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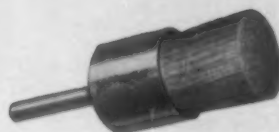
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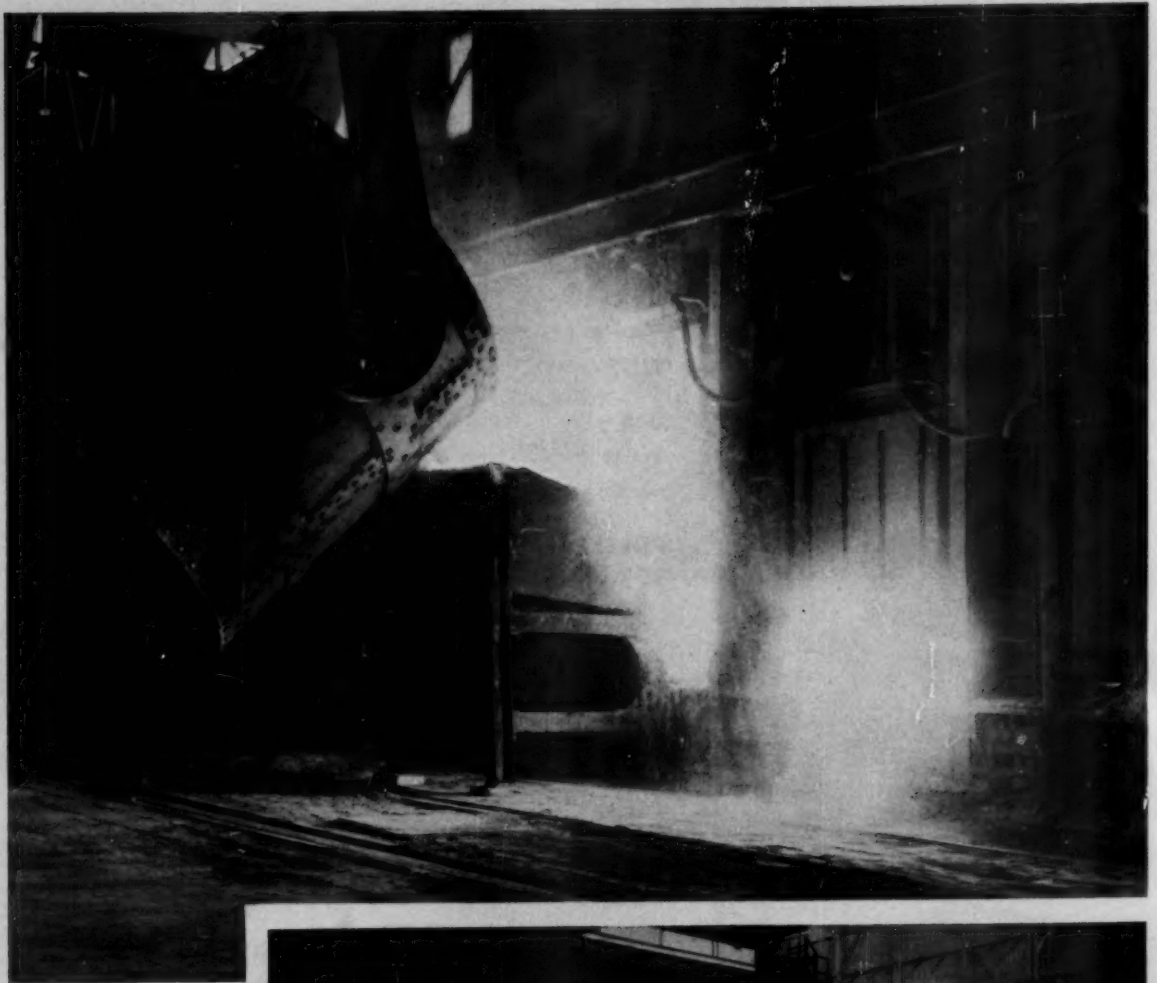
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Automobile Engineer, March 1958

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21

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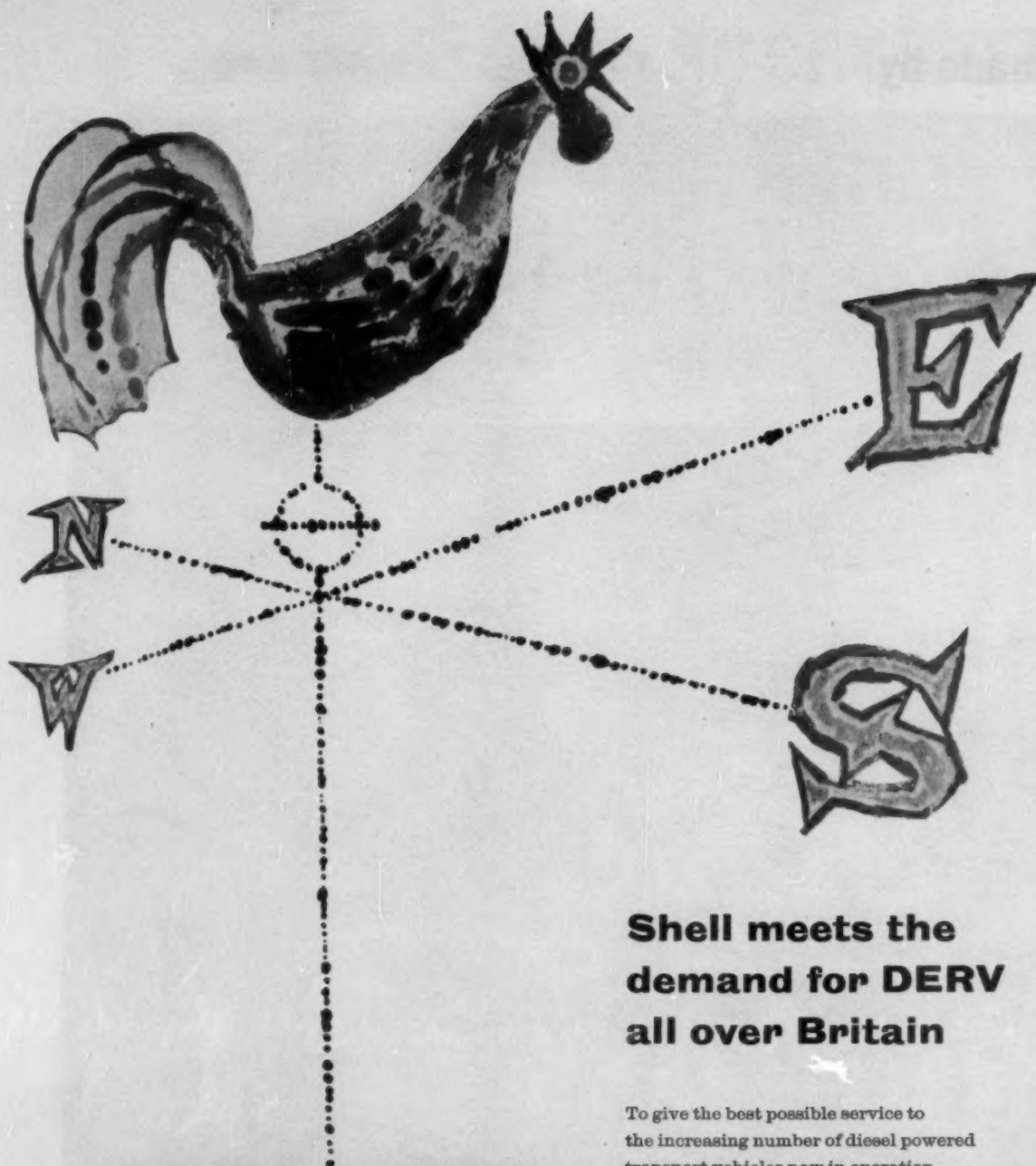
The ingot stripper bay at Abbey Works

is made by

THE STEEL COMPANY OF WALES LIMITED



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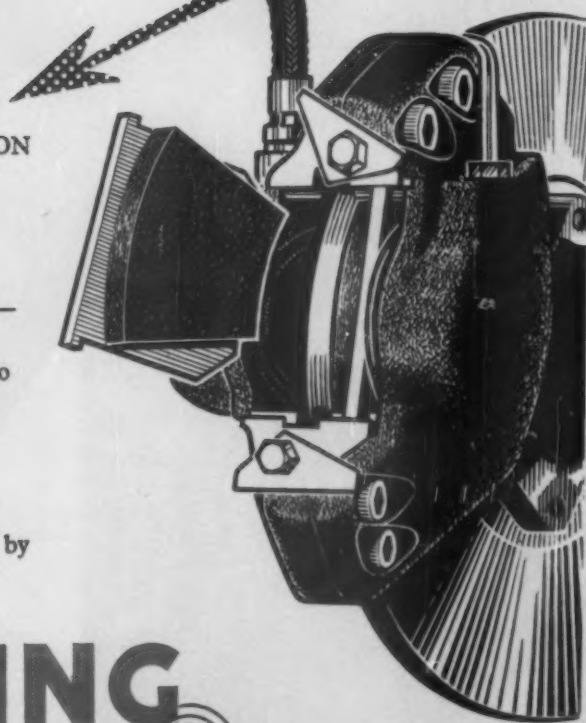
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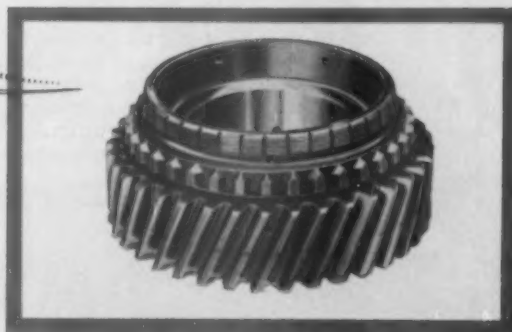


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Specialists in
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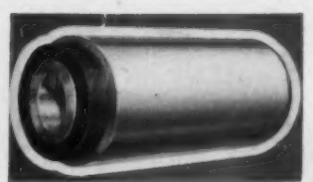
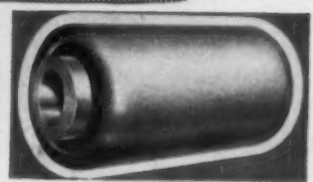


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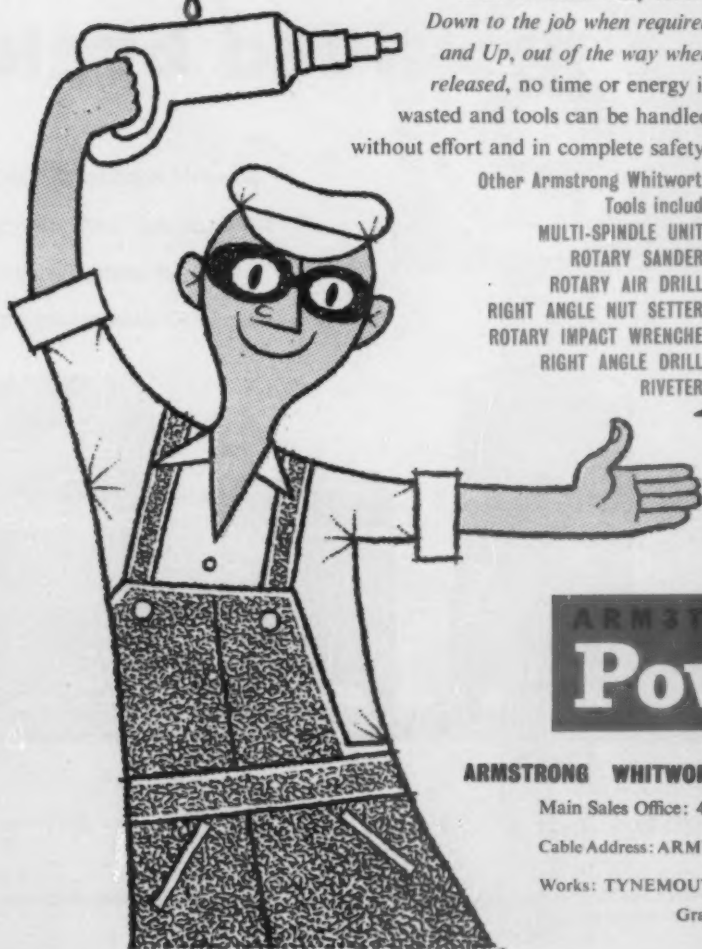
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Down to the job when required and Up, out of the way when released, no time or energy is wasted and tools can be handled without effort and in complete safety.

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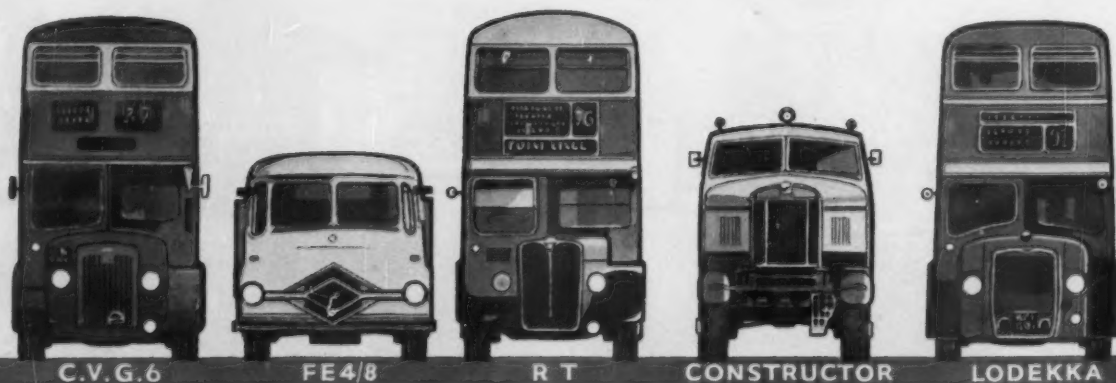
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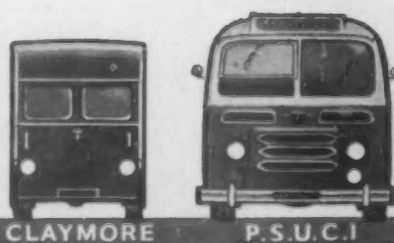
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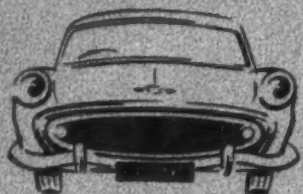
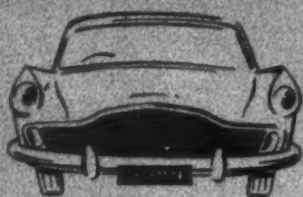
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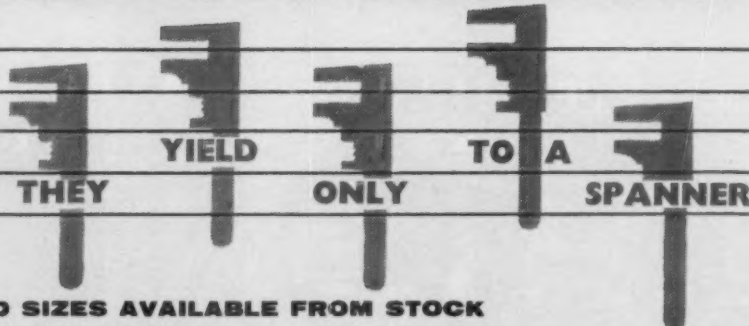
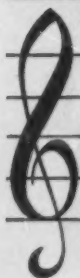
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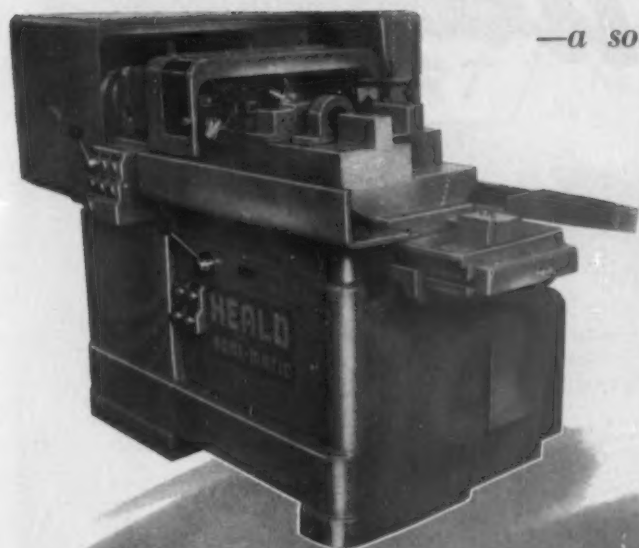
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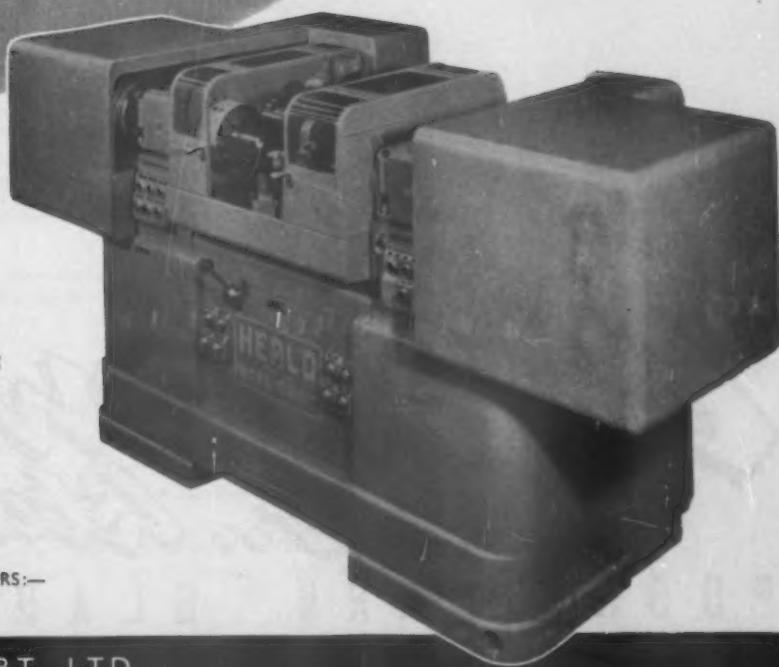
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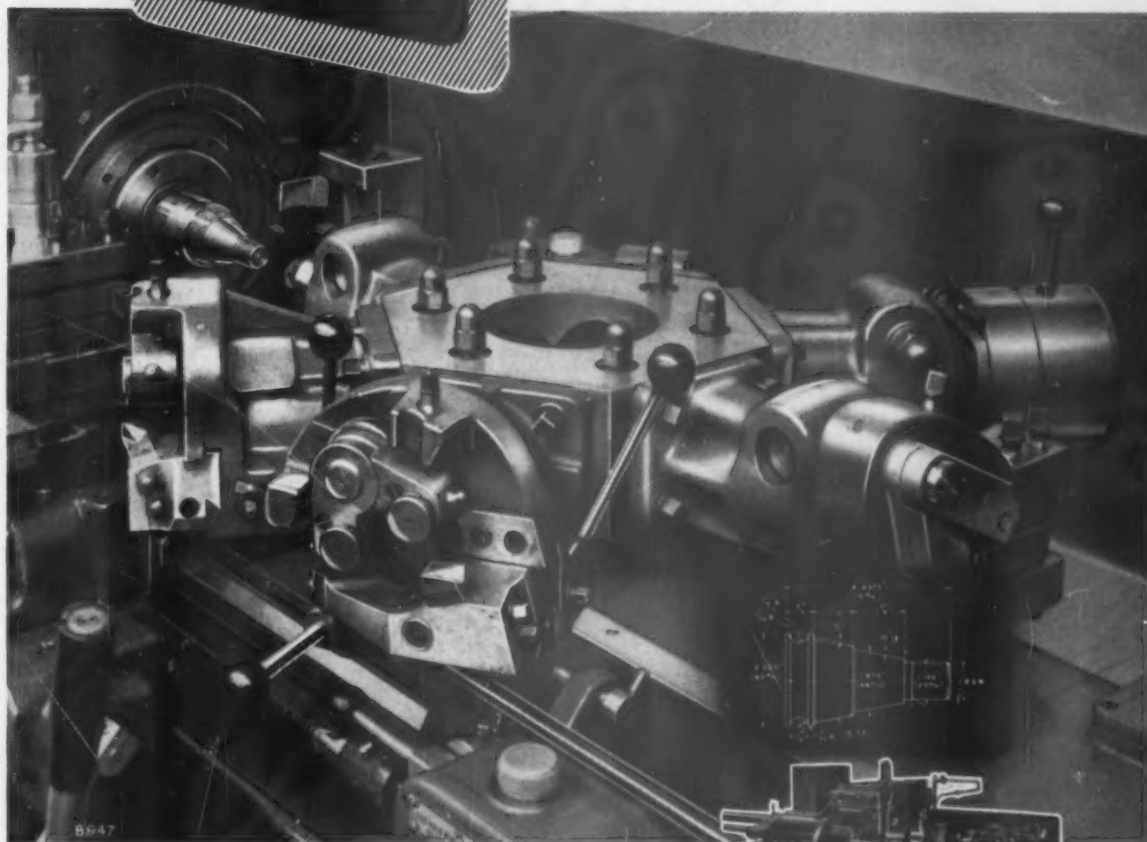
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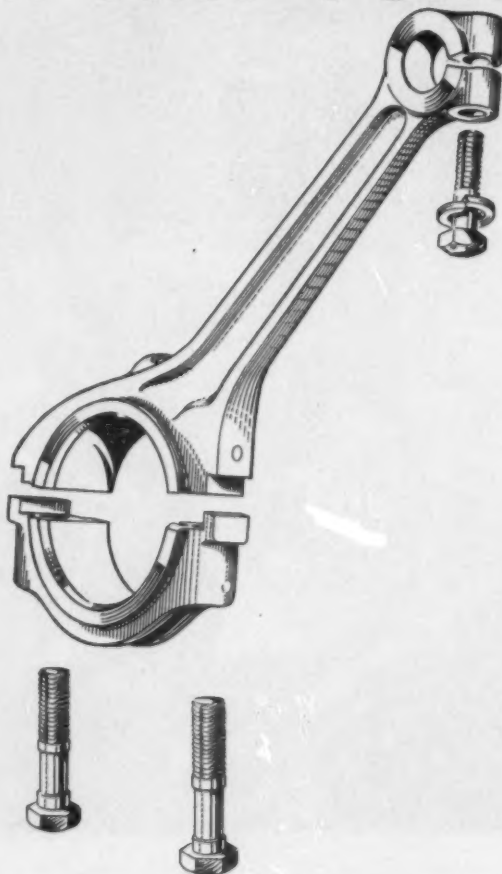
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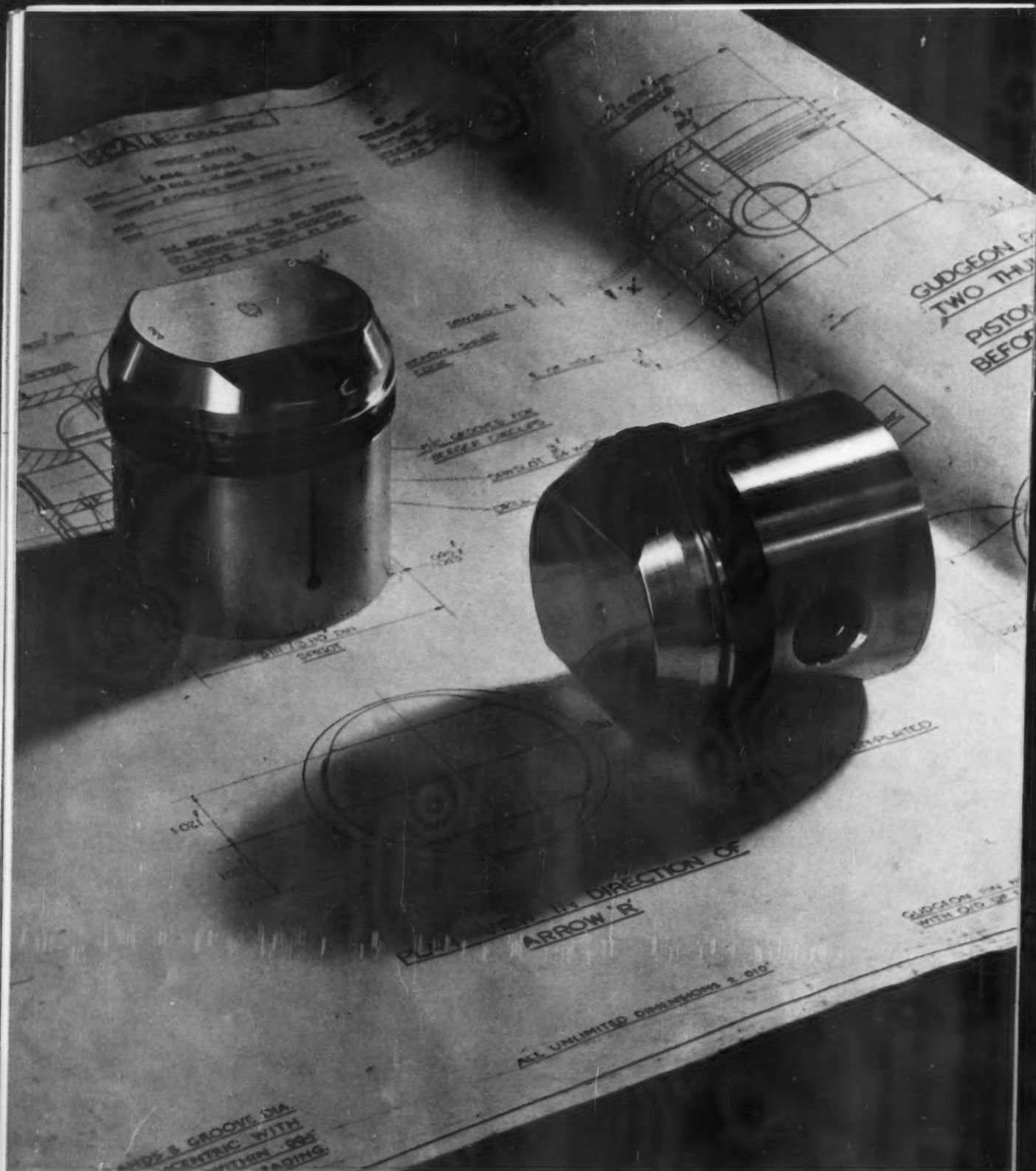
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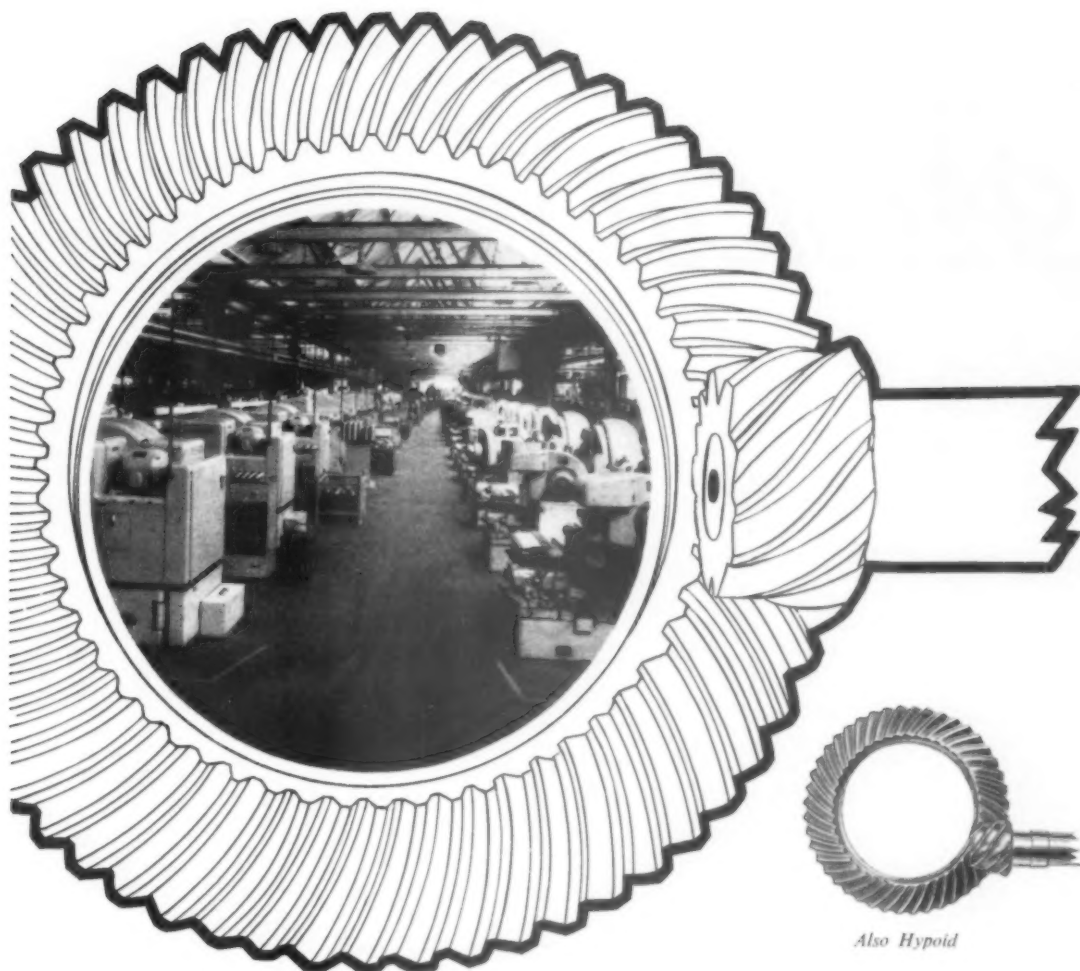
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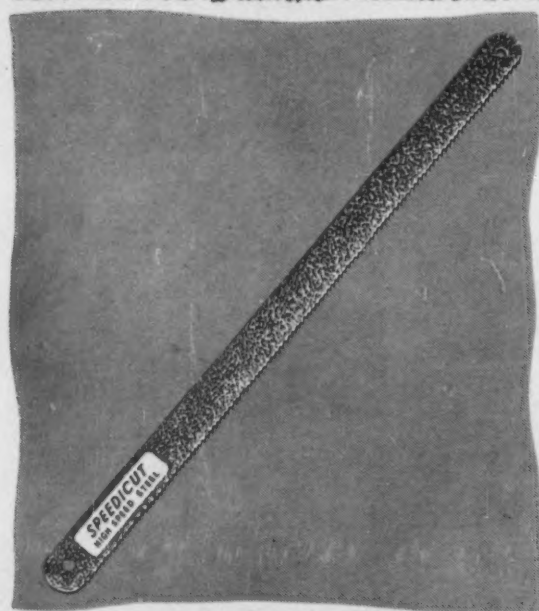
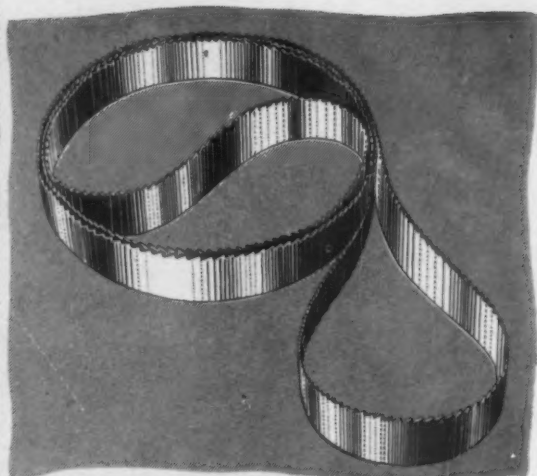
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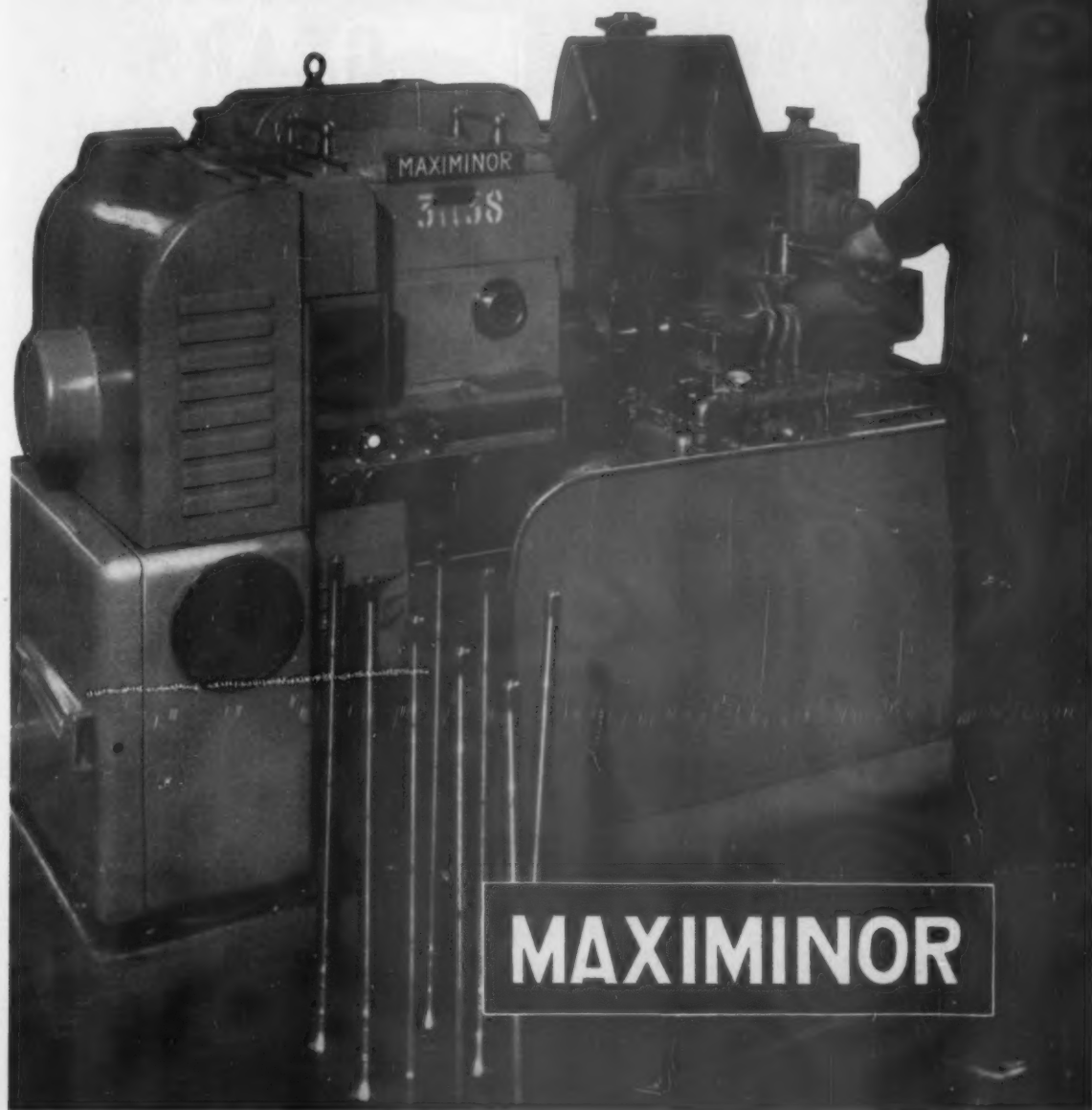
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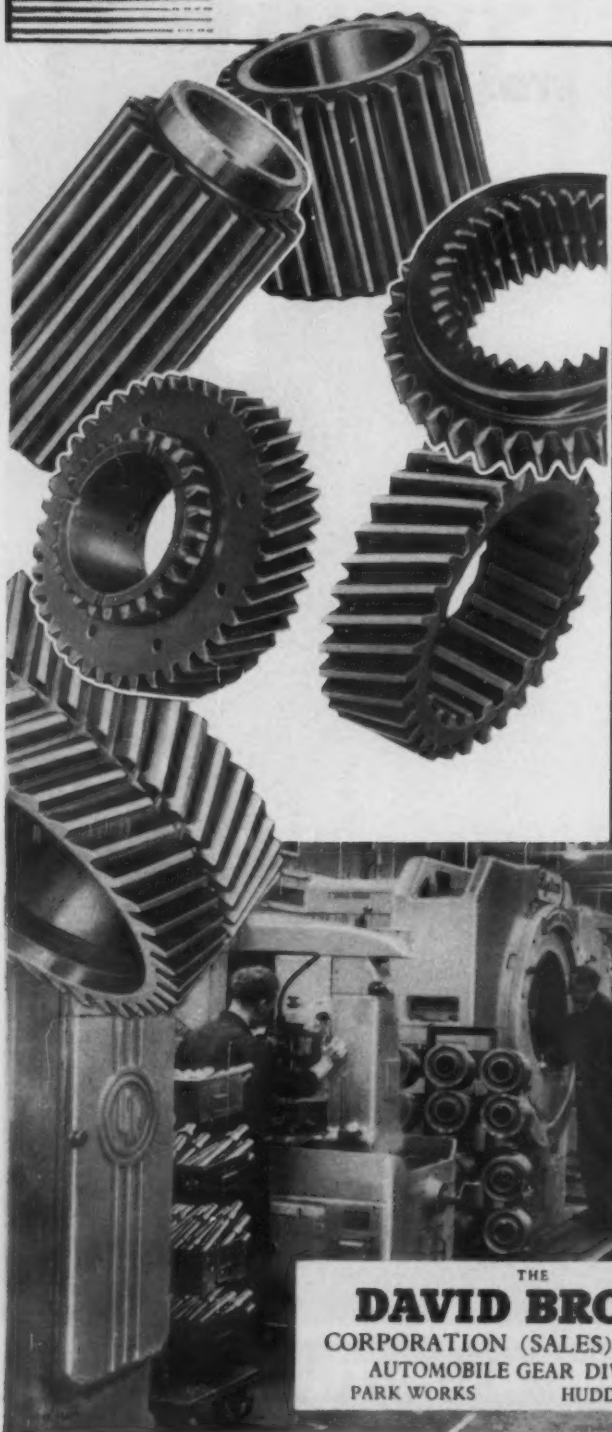
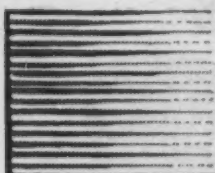
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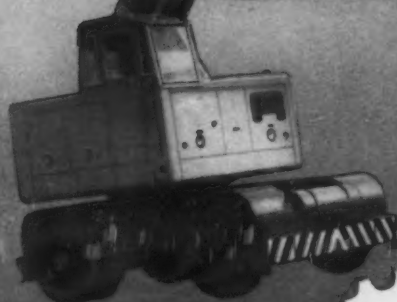
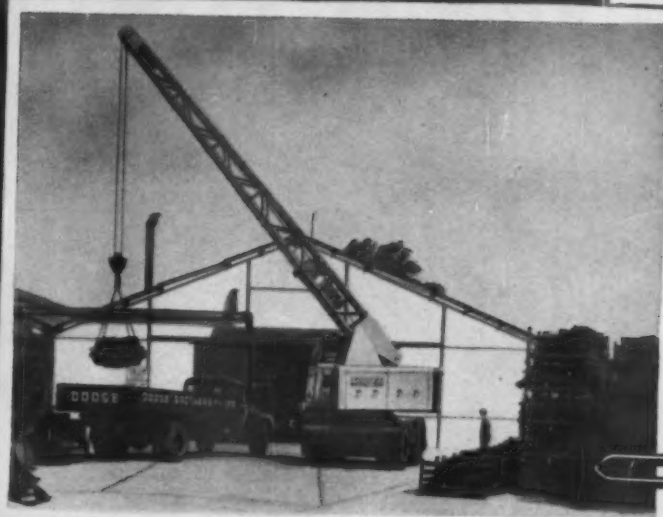


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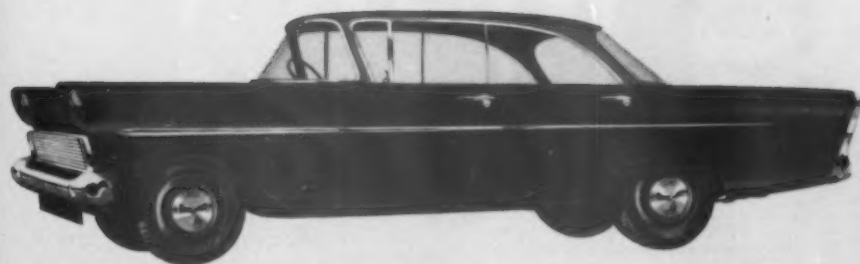
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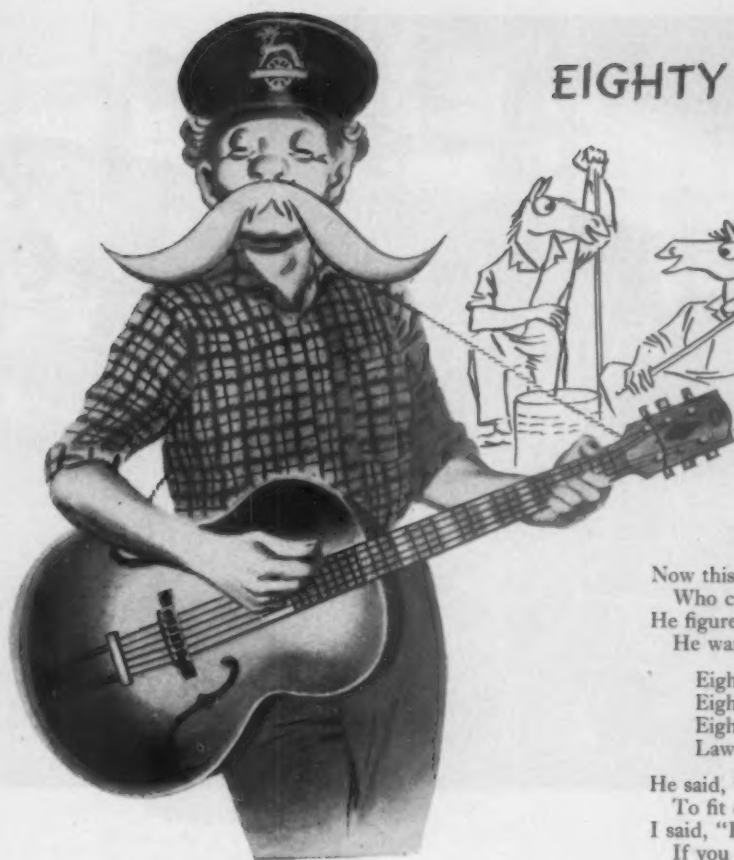
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He figured he hadn't got time to kill;
He wanted a tool that would quickly drill...

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Eighty holes in a freight train waggon,
Eighty holes in a freight train waggon,
Lawdie, what a Power Tool.

He said, "You don't know what a while it takes
To fit ev'ry waggon with hydraulic brakes."
I said, "It'll take much longer still
If you don't never use no Rackfeed Drill."

Eighty holes etc.

He went to the East for to give it a test,
Then he tried it for size on the old Great West
An' he said, "By Donegan, sump'n's wrong:
It's a wunnerful drill but it's far too long."

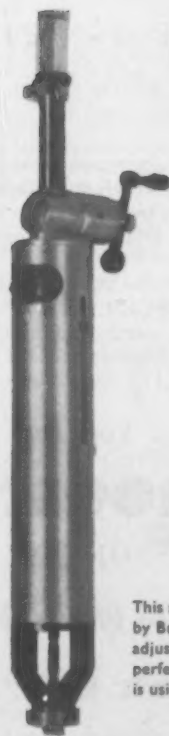
Eighty holes etc.

Now I wasn't gonna lay me down and die,
An' I thought, what the heck, I'll give it a try.
Sure my dentist says it was most unwise,
But I chewed it down to the perfect size.

Eighty holes etc.

Now I reckon I've made it mighty plain,
If our tools ain't right, then we tries again
An' in case you forget, I can only urge
That you sings to yourself this 'orrible dirge...

Eighty holes in a freight train waggon,
Eighty holes in a freight train waggon,
Eighty holes in a freight train waggon,
Lawdie, what a Power Tool.



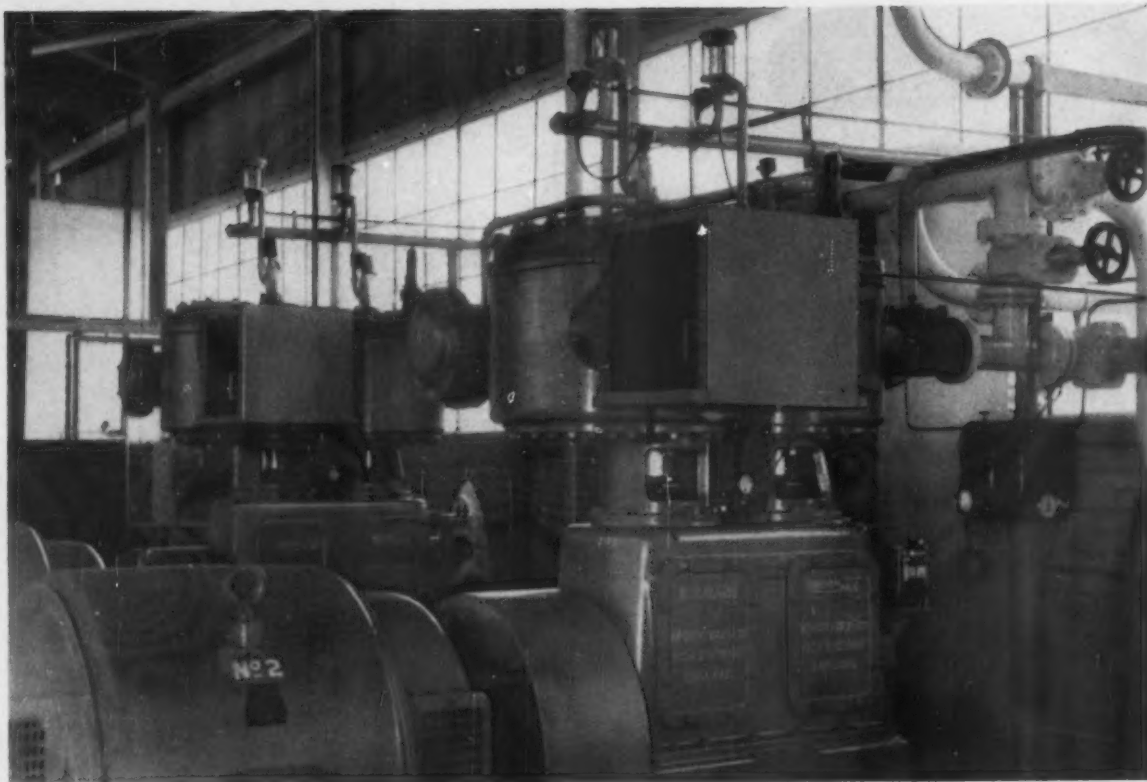
This shortened version of the Rackfeed Drill, ordered by British Railways and their contractors, has a bayonet nose adjustment which locks on to the jig plate. This guarantees perfect alignment even when an unskilled operator is using the tool.

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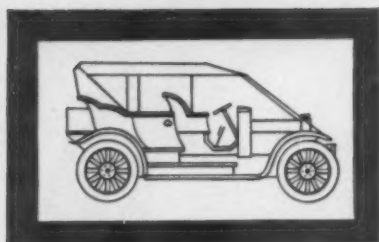
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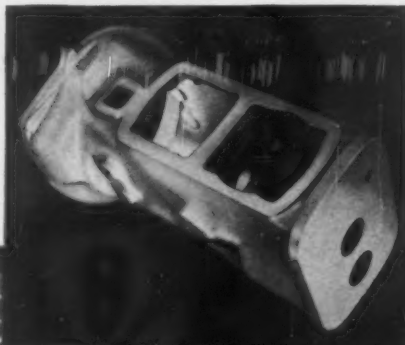
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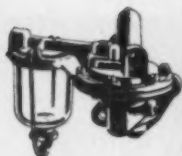
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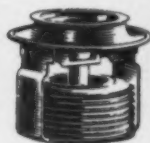


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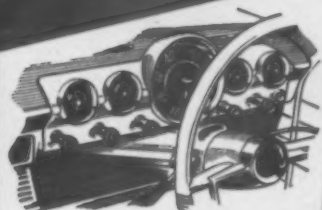
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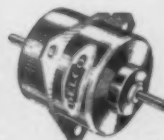
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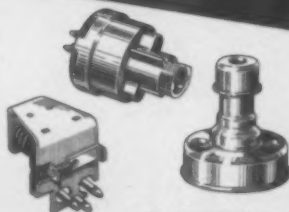
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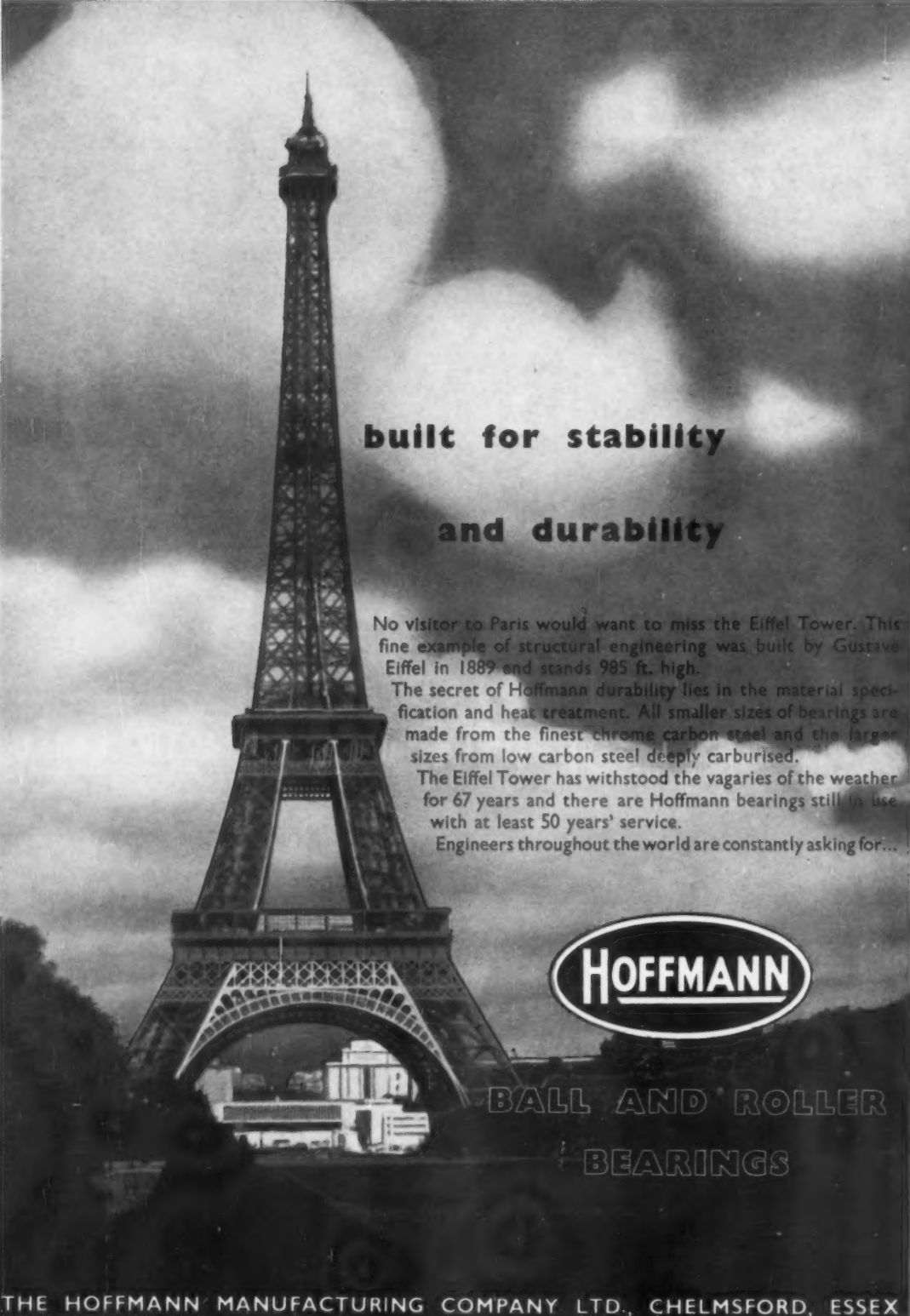


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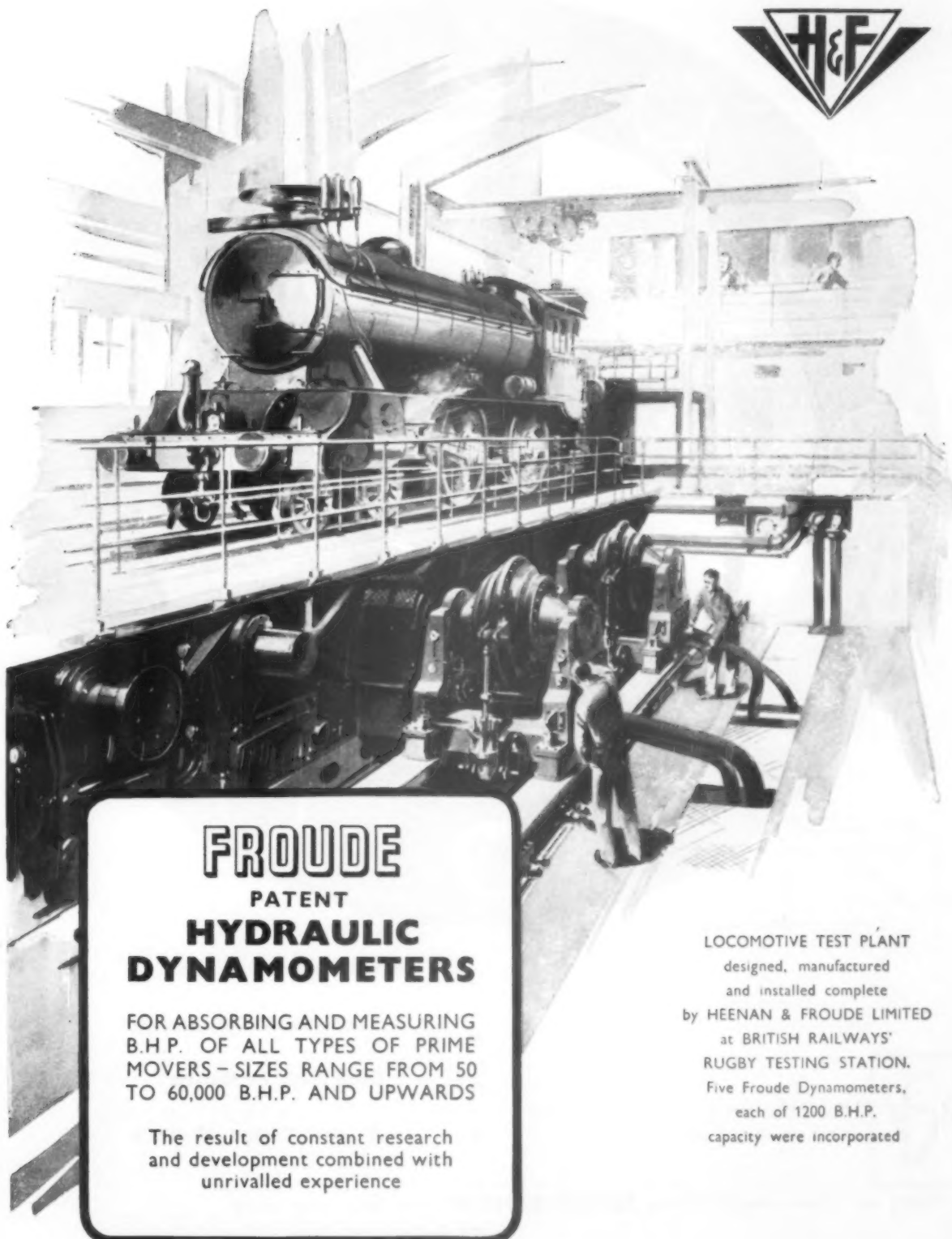
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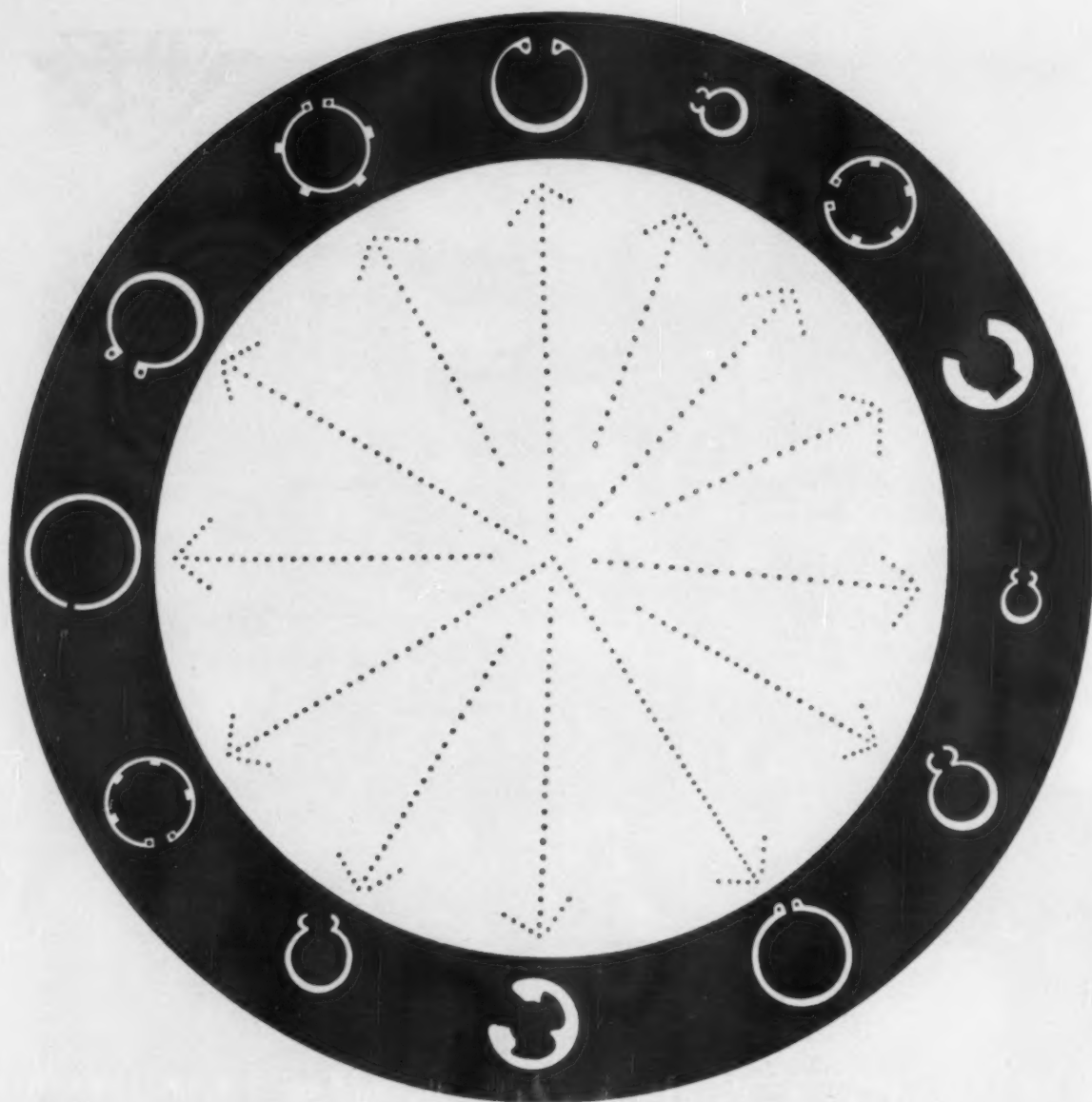
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This heavy duty Horizontal Spindle Surface Grinder fully meets modern requirements for a machine capable of highly accurate work at maximum production rates. Available in three sizes with work table capacities of 30" x 15", 48" x 15" and 72" x 15".

Designed for heavy duty and continuous high speed precision working.

Electronically controlled intermittent cross feed. Provision for accurate reversal when grinding recessed faces.

Variable automatic vertical feed with pre-set automatic cut-out.

Hydraulic table traverse up to 100 feet per minute.

Table traverse ways automatically lubricated from oil supply independent of hydraulic system.

Permanently protected precision ground slideways.

Electrically driven slow cross traverse for wheel truing.

Grinding wheel spindle electrically interlocked against starting until lubricating pump is running.

THE CHURCHILL MACHINE TOOL CO. LTD., BROADHEATH, nr. MANCHESTER
Telephone: Altrincham 3262.

Telegrams: Churchale, Manchester

Export Sales Organisation:

Associated British Machine Tool Makers Ltd.,
London, Branches and Agents

Home Selling Agents:

Charles Churchill & Co. Ltd., Birmingham and
Branches



PRECISION *plus* PRODUCTION

C663-1A



**ON THE SCAMMELL
POWER TAKE-OFF**

TRAILING-LINK FLEXIBLE couplings

The Metalastik Trailing Link Coupling is one of the most compact forms of coupling and occupies the minimum of axial length in relation to the parallel misalignment accommodated. It also takes care of angular misalignment and end float while cushioning shock loads and smoothing out torque irregularities. It has a high capacity for occasional overloads.

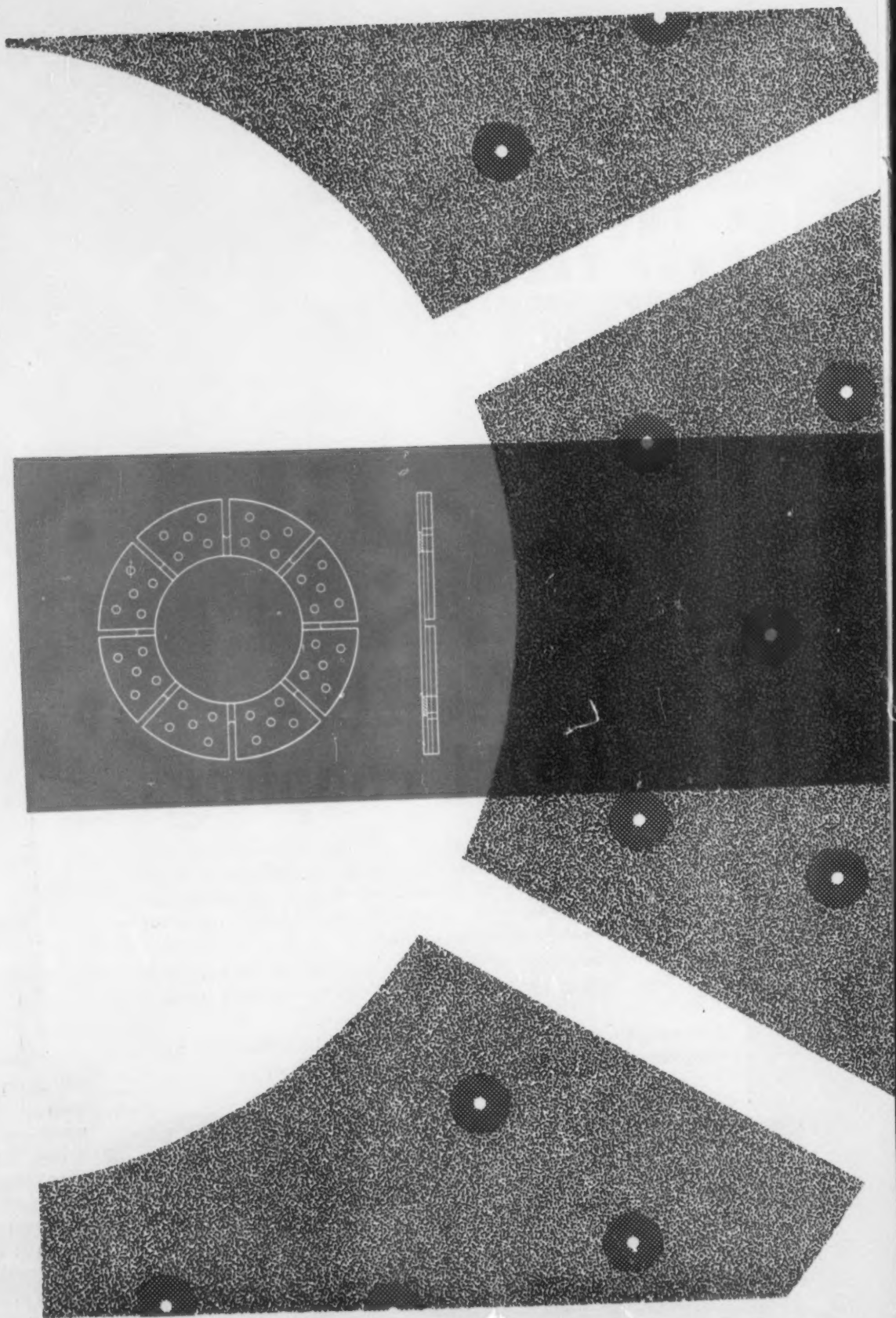
In the drive from gearbox to three-cylinder air-compressor on a Scammell road tanker, as illustrated, a Trailing Link Coupling transmits a torque of 2,250 lb./ins.

The small illustration shows the famous Metalastik Ultra-Duty Bush which takes movement in the links of the coupling.

METALASTIK

METALASTIK LTD. LEICESTER

For main as well as auxiliary drives, Trailing Link Couplings are manufactured in a range of sizes to transmit 1-20 h.p. at 100 r.p.m.



SINTERED METALS

Ferodo give the facts

Sintered Metal Clutch Facings have very different physical properties from the familiar asbestos based facings, and in certain automotive applications give improved performance.

High Thermal Conductivity gives

- * LONG LIFE
- * MINIMUM DISTORTION
- * COOLER RUNNING
- * MINIMUM HEAT CHECKING

Ferodo Sintered Metals withstand

- * HIGH TEMPERATURES
- * HIGH OPERATING PRESSURES

Reduced ratio of static to dynamic friction coefficients leads to

- * SMOOTH ENGAGEMENT

Ferodo Sintered Metal Qualities

- SM.1 General purpose material for dry and oil immersed applications.
- SM.2 For oil immersed applications requiring smooth, gradual engagement such as automotive automatic transmissions.
- SM.3 Specially suited to dry, heavy duty applications such as engine master clutches on trucks and on tractor steering clutches.
- SM.4 Is intended as a mating surface for use against other Ferodo sintered metals to protect costly parts from heat damage and wear.
- SM.5 For oil immersed applications involving long slip periods such as seals and tension controlled clutches.
- SM.6 For oil immersed applications where smooth engagement must be coupled with relatively high rating.

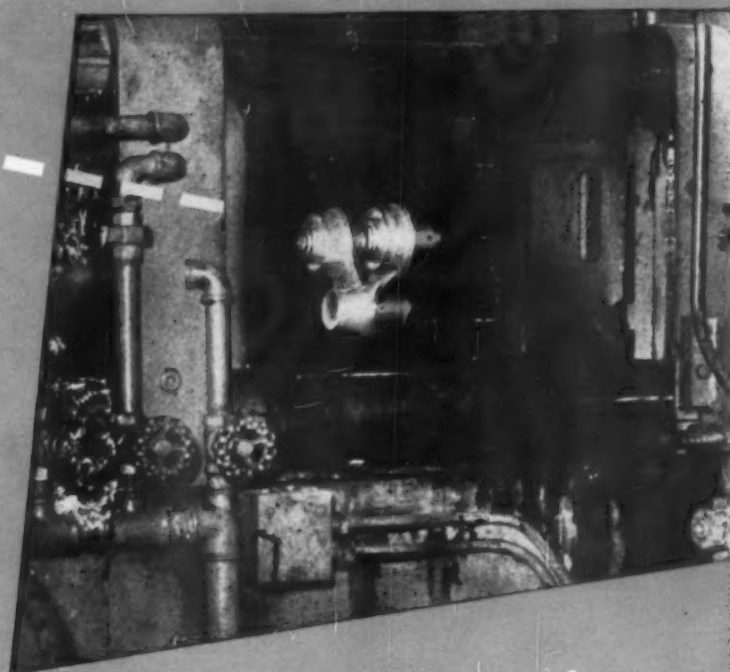
FERODO

Sintered Metal Clutch Facings

Write to us for further technical information and brochure

FERODO LIMITED · CHAPEL-EN-LE-FRITH A Member of the Turner & Newall Organisation

**QUALITY
IN
QUANTITY**



Reliable Pressure Die Castings



Whenever castings to fine limits are required for quantity supply the pressure die process can show considerable savings, both in cost and final machining requirements.

When these quantity castings are required to a high standard of quality then we should be called in at an early stage to design and manufacture the dies, when you will find our considerable experience of great assistance.

We are recognised as the suppliers of quality castings in Zinc and Aluminium alloy for a variety of industries. Could we not help you?

West Yorkshire

SAYNER LANE, LEEDS 10
Telephone: Leeds 29406



Foundries Ltd.

London Office: HANOVER HOUSE, HANOVER SQ., W.1
Telephone: MAYfair 6661

A BIG NAME IN NUTS!

We're not going to *say* we make the best nuts in the world (though that doesn't stop us thinking so, does it?) but we do suggest that when you're buying Bar Turned or Cold Formed Nuts it's worth remembering our name. We manufacture large quantities in a wide range of sizes, steels and finishes—and if you want a special nut or turned part for a special job, we can supply it.

SIMMONDS AEROCESSORIES LIMITED

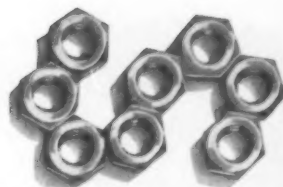
TREFOREST : PONTYPRIDD : GLAMORGAN

Branches: London, Birmingham, Manchester,
Glasgow, Stockholm, Copenhagen, Ballarat,
Sydney, Johannesburg, Amsterdam,
Milan and New York



A MEMBER OF THE FIRTH CLEVELAND GROUP

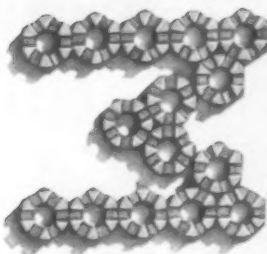
CRC 3121



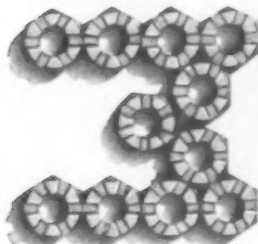
COLD FORMED
DOUBLE CHAMFERED
STEEL NUTS



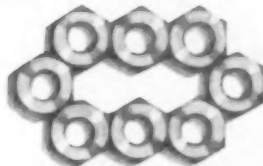
FULL NUTS



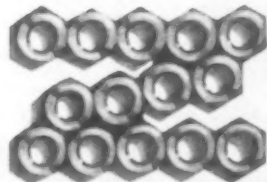
SLOTTED NUTS



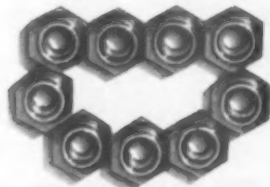
ROUND TOP
CASTLE NUTS



THIN LOCK NUTS



SPECIAL NUTS



ROOT NUTS



SPECIAL COLD
FORMED NUTS



Hidden Treasures

Deep in the heart of the Central American jungles are hidden temples of a long-lost civilisation—gems of architecture which have successfully withstood the test of time.

*And deep in the heart of the world's finest car engines another treasure is hidden . . . silent . . . enduring . . . vital . . . a **Renold Timing Chain**. It's a gem of a chain—smooth running and flexible, capable of innumerable driving arrangements and outliving the engine itself.*

RENOLD TIMING CHAINS

stand the test of time



RENOLD — the *FIRST* name in precision chain

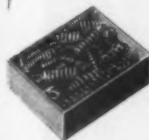
RENOLD CHAINS LIMITED • MANCHESTER

SEE THE SPRING YOU NEED HERE?

Cut
production costs with
TERRY
Wire Circlips
(Square Section)

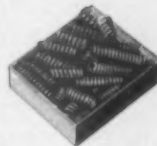


We make
first-class
Flexible Shaft
too.
May we quote you?



No. 757. Extra Light
Compression, 1 gross
Assorted, $\frac{1}{4}$ " to $\frac{1}{2}$ ",
 $\frac{1}{4}$ " to 2" long, 27 to
20 S.W.G. 15/- each.

No? Well, it would take all the pages of this magazine—and a lot more—to show in full the immense range of TERRY'S ASSORTED SPRINGS in all their variety—compression, expansion, heavy, light, long, short, any gauge you want. But in our BOXES OF ASSORTED SPRINGS you'll certainly find the very spring you've been looking for. Why not let us send you our full illustrated list of BOXES—post free?



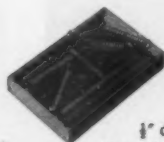
No. 98A. 3 doz. As-
sorted 1" to 4" long,
 $\frac{1}{4}$ " to $\frac{1}{2}$ " diam., 19G
to 15G. 5/6 each.



No. 758. Fine Expansion Springs.
1 gross Assorted $\frac{1}{4}$ " to $\frac{1}{2}$ ", $\frac{1}{4}$ " to 2"
long, 27 to 20 S.W.G. 15/- each.

TERRY'S ASSORTED SPRINGS

HERBERT TERRY & SONS LTD. REDDITCH, WORCS.
(Makers of quality Springs, Wireforms & Presswork for over 100 years)

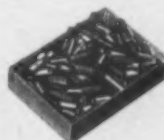


No. 753. 3 doz.
Assorted Light
Expansion $\frac{1}{4}$ " to
 $\frac{1}{2}$ " diam., 2" to 6" long,
22 to 18 S.W.G. 10/6 each.

No. 1024. 20 Compres-
sion Springs 12" long. $\frac{1}{4}$ "
to $\frac{1}{2}$ " diam., 24G to
18G, suitable
for cutting
into shorter
lengths; and
30 Expansions
11" to 12" long,
 $\frac{5}{32}$ " to $\frac{1}{2}$ " diam.,
22G to 16G. 24/- each.



Interested in Spring
Design? Send for "Spring Design
and Calculations"—Post free 12/6



No. 388. $\frac{1}{2}$ gross Assorted Small
Expansion Springs. $\frac{1}{4}$ " to $\frac{1}{2}$ ", 18G
to 21G. 9/6 each.



No. 760.
3 doz. Assorted
Light Compression
Springs. 1" to 4"
long, 22 to 18 S.W.G.,
 $\frac{1}{4}$ " to $\frac{1}{2}$ " diam. 6/6 each.

HT 23

AVDEL LOCKBOLTS

NOW AVAILABLE IN THE UNITED KINGDOM!

REGD

Replace nuts and bolts and rivets

We announce that, by arrangement with the Huck Manufacturing Company of Detroit, U.S.A., the well-proven Huck type High-Strength Lockbolt is now available from British manufacturing sources.

This revolutionary, American high-speed fastening system will replace traditional fasteners at present used in the fabrication of metal structures, and enable British manufacturers to cut costs and speed production.



Lockbolts are used extensively in the U.S.A. in shipbuilding, coachbuilding, structural engineering, chassis fabrication, and many other industries.

Write now for full details.

LOOK AT THESE ADVANTAGES!

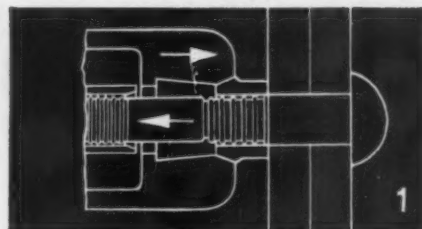
- ★ Driven with high-speed pneumatically-operated hand tool.
- ★ Rapid driving increases production and cuts labour costs.
- ★ Driving is completely automatic—skilled labour not required.
- ★ Positively and mechanically self-locking and vibration proof.
- ★ High shear and tension strength and high fatigue resistance.
- ★ Automatically placed at uniform pre-tension.
- ★ High positive clench and sealing qualities.
- ★ High quality work regardless of operators' skill.
- ★ Quiet and easy operation reduces operator fatigue.
- ★ Not necessary to provide spanner clearance in design.

AVDEL LOCKBOLTS

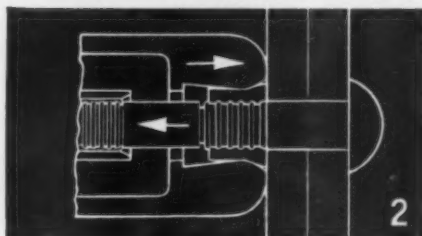
REGD. BRITISH PATENTS 619099, 766137, OTHER BRITISH AND FOREIGN PATENTS GRANTED AND PENDING.

Available in high-strength aluminium alloys and steel

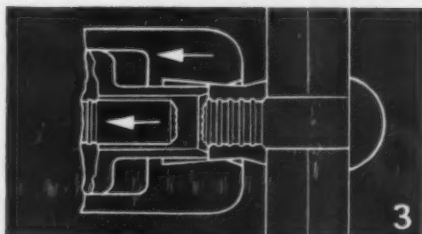
DRIVING CYCLE



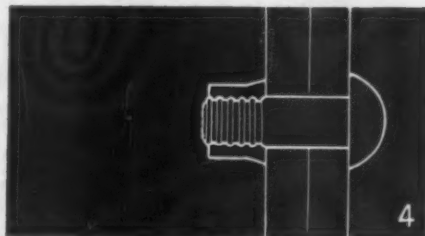
High clenching action clamps sheets together.



Collar swaged and locked into grooves.



Bolt breaks at breakneck groove.



Installed lock bolt.

AVIATION DEVELOPMENTS LIMITED

KINGSBOURNE HOUSE, 229-231, HIGH HOLBORN, LONDON, W.C.1.

Telephone: CHAncery 8601

AD 19

★ **CONSISTENCY . . . FIRST TO LAST!**

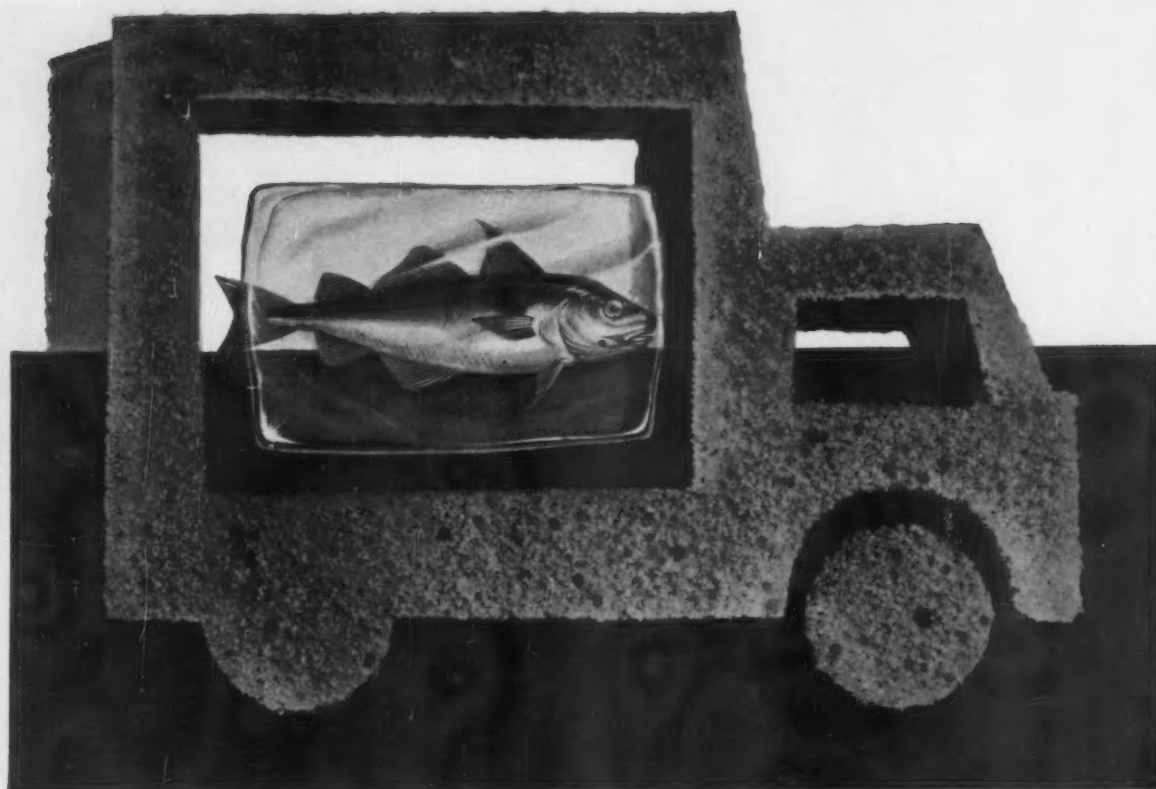


DORMER

WE insist on accuracy to the finest detail. Very high standards are maintained, and every feature of each **DORMER TOOL** is inspected at all stages of manufacture. The fact that more than 130 Inspectors are so employed is the measure of the emphasis we place on precision. Consistency in manufacture is proved in the performance of every tool marked **DORMER**.

**THE
SHEFFIELD TWIST DRILL
& STEEL COMPANY LIMITED
SHEFFIELD · ENGLAND**

**DORMER TOOLS ARE OBTAINABLE
FROM YOUR USUAL ENGINEERS'
MERCHANTS**



new insulation—light and strong

with **Isocyanates**

and **POLYESTERS** by



These simple-to-mix components give strong, lightweight rigid foams

to provide an insulating material of particular value in the construction of refrigerated vehicles.

Easily mixed on the site, the components produce the foam in the cavity to be filled.

*As this happens, a bond is formed with the wood or metal with which the foam is in contact
adding strength and rigidity to the structure.*

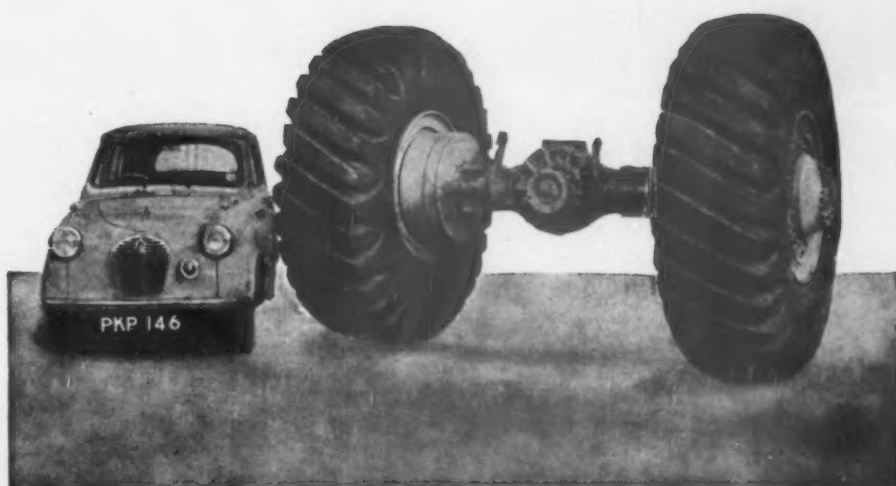
Ask for details of 'Daltolac' 21 and 'Suprasec' D Enquiries should be addressed to:
I.C.I. Sales Development Department (Polyisocyanates),
Ship Canal House, King Street, Manchester 2.

IMPERIAL CHEMICAL INDUSTRIES LIMITED LONDON SW1 ENGLAND

D.881

KIRKSTALL AXLES

FOR ALL DUMPERS



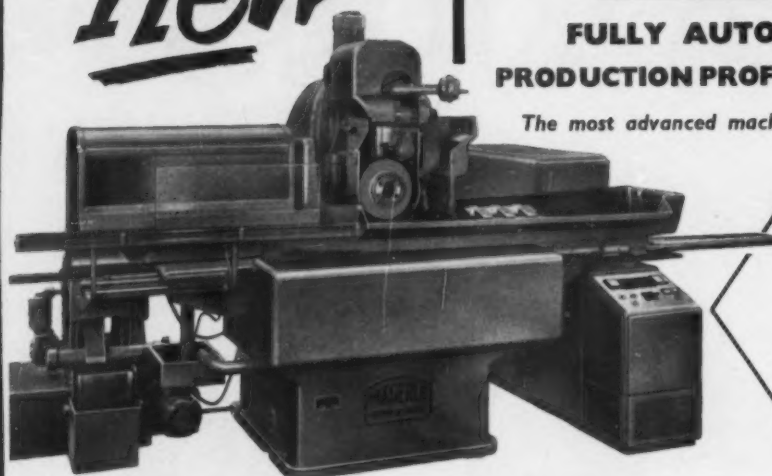
**KIRKSTALL FORGE ENGINEERING
LIMITED** **LEEDS, 5**

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MARBAIX

FOR UNUSUAL MACHINES

new



MÄGERLE

FULLY AUTOMATIC PRODUCTION PROFILE GRINDER

The most advanced machine of its type

ENTIRELY
AUTOMATIC
EXCEPT FOR
LOADING &
UNLOADING

THREE SIZES WITH WHEELS UP TO 4in. WIDE

MODEL FP 7A TABLE WORKING SURFACE 29 $\frac{1}{2}$ in. by 9 $\frac{7}{8}$ in.

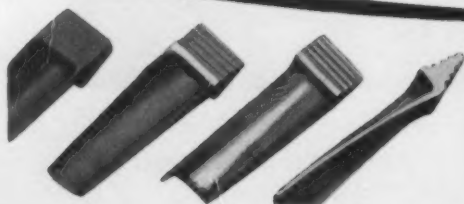
MODEL FP10A TABLE WORKING SURFACE 41 $\frac{1}{2}$ in. by 9 $\frac{7}{8}$ in.

MODEL FP12A TABLE WORKING SURFACE 49 $\frac{1}{2}$ in. by 9 $\frac{7}{8}$ in.

ALL MODELS HAVE 15 $\frac{1}{2}$ in. CLEARANCE UNDER WHEEL

WRITE FOR FULL DETAILS TO DEPT. AE.10

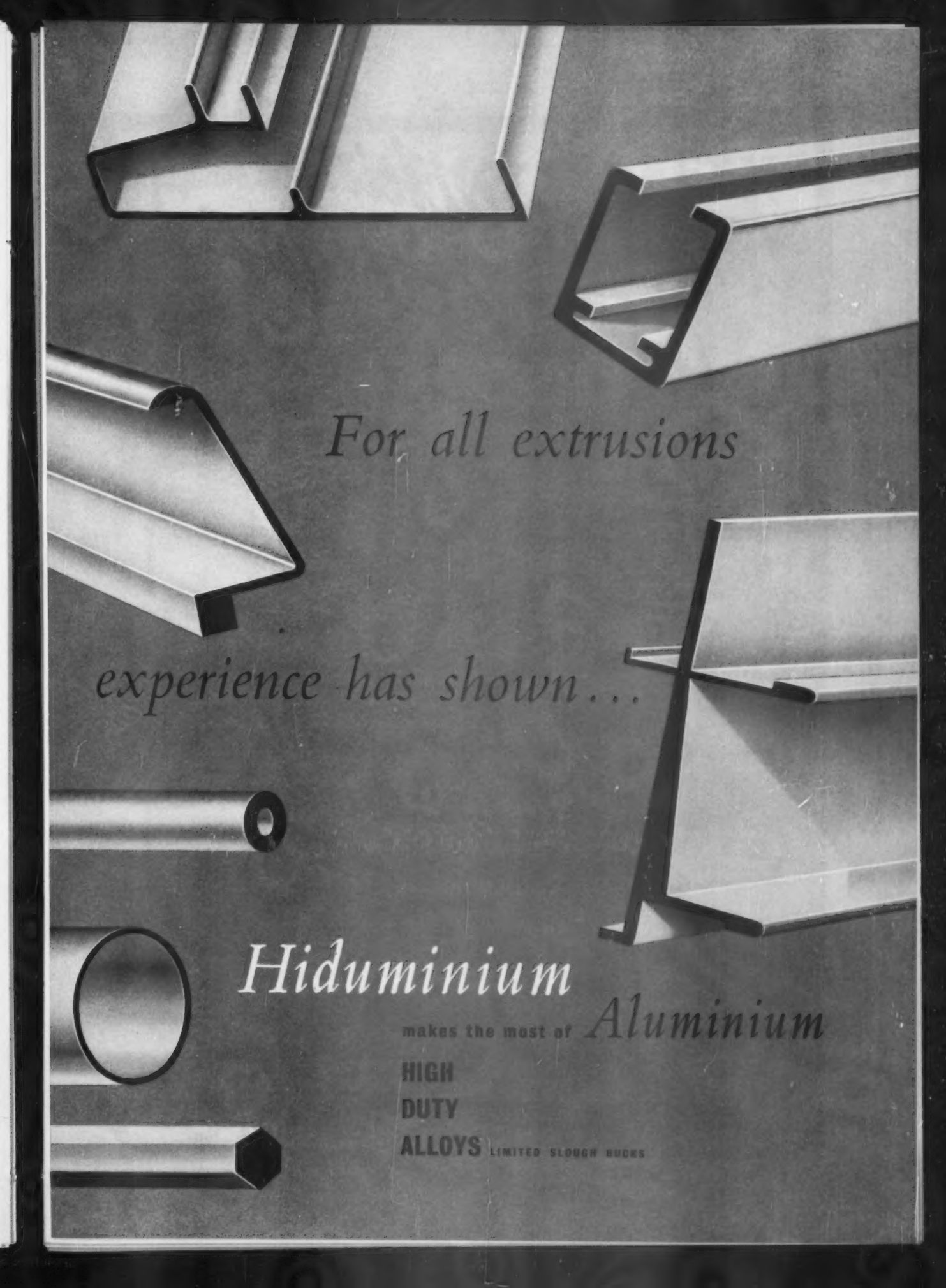
- WHEEL PERIPHERAL SPEED CONSTANT
- AUTOMATIC SIZING WITHIN 0.0002in.
- NEW PATENTED WAYS GIVING ABSOLUTE RIGIDITY & PRECISION
- AUTOMATIC ADJUSTMENT OF WHEEL SPEED COMPENSATES FOR WEAR



◀ TYPICAL FIR TREE ROOT GROUND FROM
SOLID TO PITCH LIMITS OF 0.0002in.

GASTON E. MARBAIX LTD

DEVONSHIRE HOUSE, VICARAGE CRESCENT,
BATTERSEA LONDON, S W 11
PHONE BATTERSEA 8888 (8 lines)

The background of the advertisement features several different aluminum extrusion profiles. At the top left, there is a T-shaped profile. To its right is a more complex profile with multiple flanges. On the left side, there is a wide, flat profile with a curved edge. On the right side, there is a large, wide profile with a deep channel. At the bottom left, there is a circular profile and a hexagonal profile. The profiles are arranged in a way that they seem to be floating or displayed against a dark, textured background.

For all extrusions

experience has shown...

Hiduminium

makes the most of *Aluminium*

HIGH

DUTY

ALLOYS

LIMITED SLOUGH HUCKS

Who machines those prototypes?

It is not always realised that, apart from crankshaft and "CROMARD" liner production in Wolverhampton, Laystall have facilities in London and Liverpool for General Machining.

*Ask us—we may be
able to help you*



LAYSTALL ENGINEERING CO. LTD.

53 GREAT SUFFOLK STREET, LONDON, S.E.1. Telephone: WAT. 6141

Laystall Laystall Laystall Laystall Laystall

FLASHERS for SAFETY



★ *Effective—compel attention in any light*

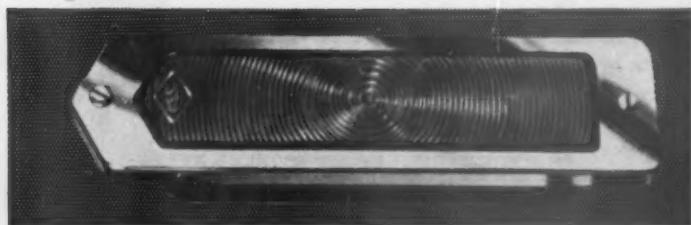
★ *Reliable—only one working part in complete installation*

Self-cancelling
Switch with
Warning Light,
suitable for
flasher operation.



Condenser
Relay Flasher
Unit with cover
removed.

CAV Flashing Indicator Equipment is designed specifically for use on buses, coaches and commercial vehicles up to the heaviest types, whilst sets are also available for tractor/trailer combinations. The lamp units are the result of much development work and their optical design ensures maximum visibility by day or night. Three types are available—circular for front or rear mounting, side mounting and arrow type. The flasher unit is extremely simple, with only one working part, and is therefore reliable; it is also easy to wire and is not vulnerable to accidental damage. Two types of switch are available—the self-cancelling type with incorporated adjustable time delay and indicator light, or a simple hand-cancelling type if required. Full particulars will be sent on request.



CAV FLASHER INDICATOR EQUIPMENT

The World's Leading Manufacturers of



**FUEL INJECTION &
ELECTRICAL EQUIPMENT**

CAV LIMITED, ACTON, LONDON, W.3



for truly silent
vibration-free
transmissions...the

RZEPPA

constant-velocity
universal joints

Here is truly constant velocity – not a modified cross-pin type joint – but a completely different design.

The UNIPOWER RZEPPA constant-velocity universal joint will work at an angle of 40° from the normal, without any speed fluctuations between driving and driven members.

Perfected by 25 years of research and development, the UNIPOWER RZEPPA c-v joint is available in a range of sizes for transmitting various horsepowers, and in two designs: for steering/driving wheels, and for independently sprung driving wheels. Please write for full details.

The UNIPOWER RZEPPA design not only ensures constant angular velocity of power transmission, it also resists axial forces in compression or elongation.

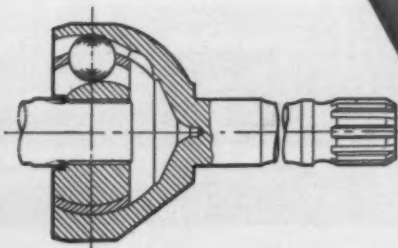
UNIPOWER RZEPPA

MEMBER OF THE



BIRFIELD GROUP

This company participates in the technical, research, and productive resources shared by Hardy Spicer Ltd · Laycock Engineering Ltd · Intermit Ltd · Phosphor Bronze Ltd · Bound Brook Bearings Ltd · Salisbury Transmission Ltd · Kent Alloys Ltd · Forgings and Presswork Ltd · and other companies famous in light engineering.



UNIPOWER RZEPPA LIMITED · Birch Road · Wotton · Birmingham 6 · Phone: Birchfield 4504

Automotive Division of **BIRFIELD INDUSTRIES LTD** · LONDON · W.1

increasing efficiency and safety

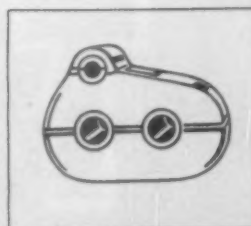
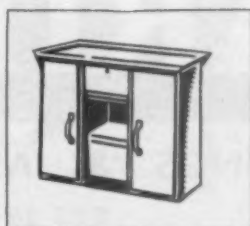
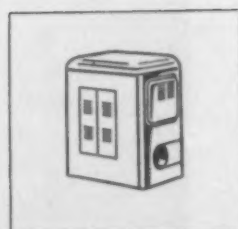
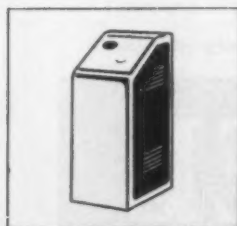


PROV. PAT. 9628/56

Skilled men and the workshop as a whole benefit from the better storage afforded by Versatool cabinets. They provide safety, careful handling and maintenance of precision tools, attachments, measuring equipment, etc. The complete accessibility to all equipment results in faster changeover and machine setting.

REGD. **THE VERSATOOL CABINET**

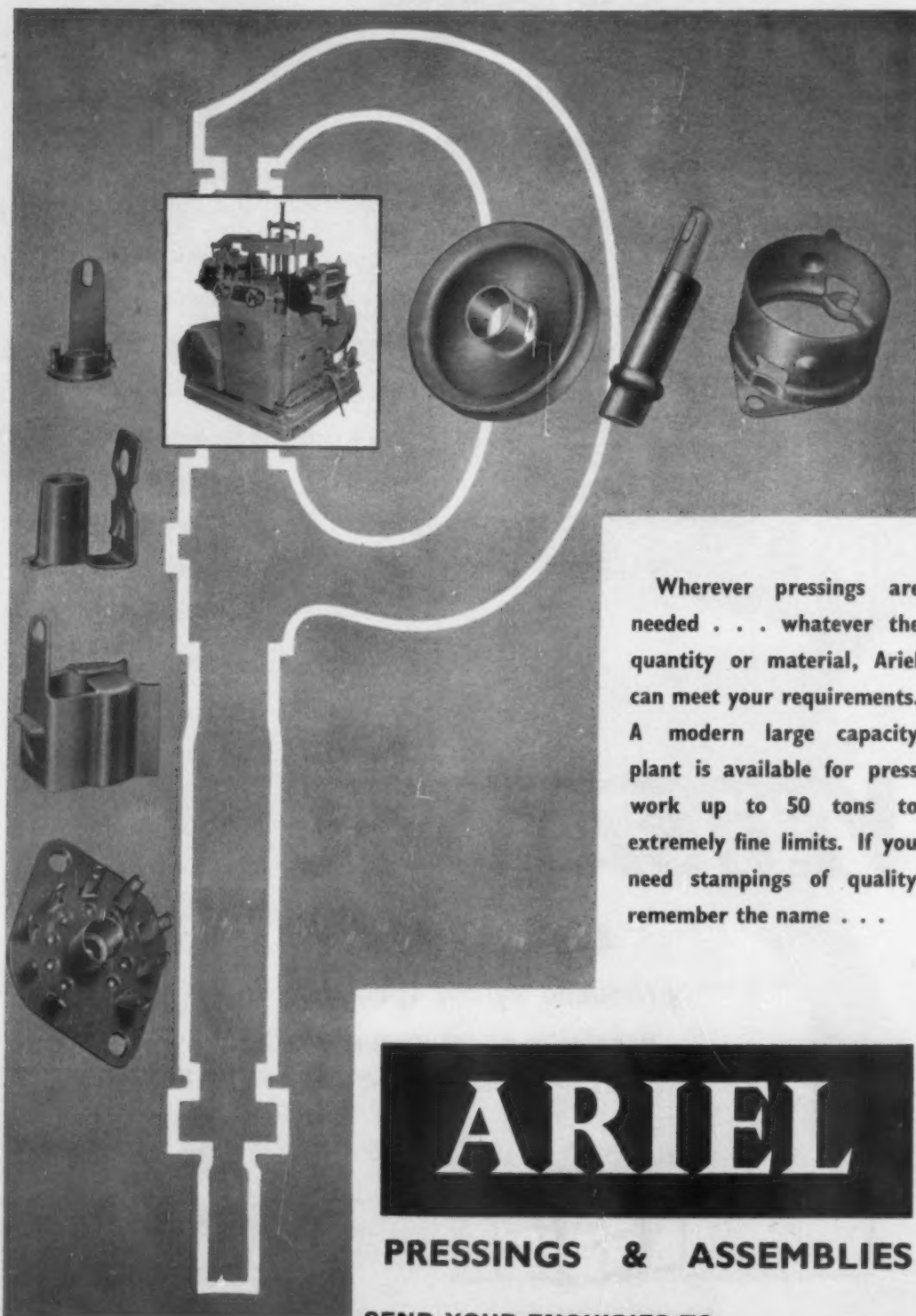
*produced by the specialists in
precision sheet metal work*



W. PINDER & SON LTD., KING ST., PETERBOROUGH

P 178

MASS PRODUCED TO FINE LIMITS



Wherever pressings are needed . . . whatever the quantity or material, Ariel can meet your requirements. A modern large capacity plant is available for press work up to 50 tons to extremely fine limits. If you need stampings of quality remember the name . . .

ARIEL

PRESSINGS & ASSEMBLIES

SEND YOUR ENQUIRIES TO:

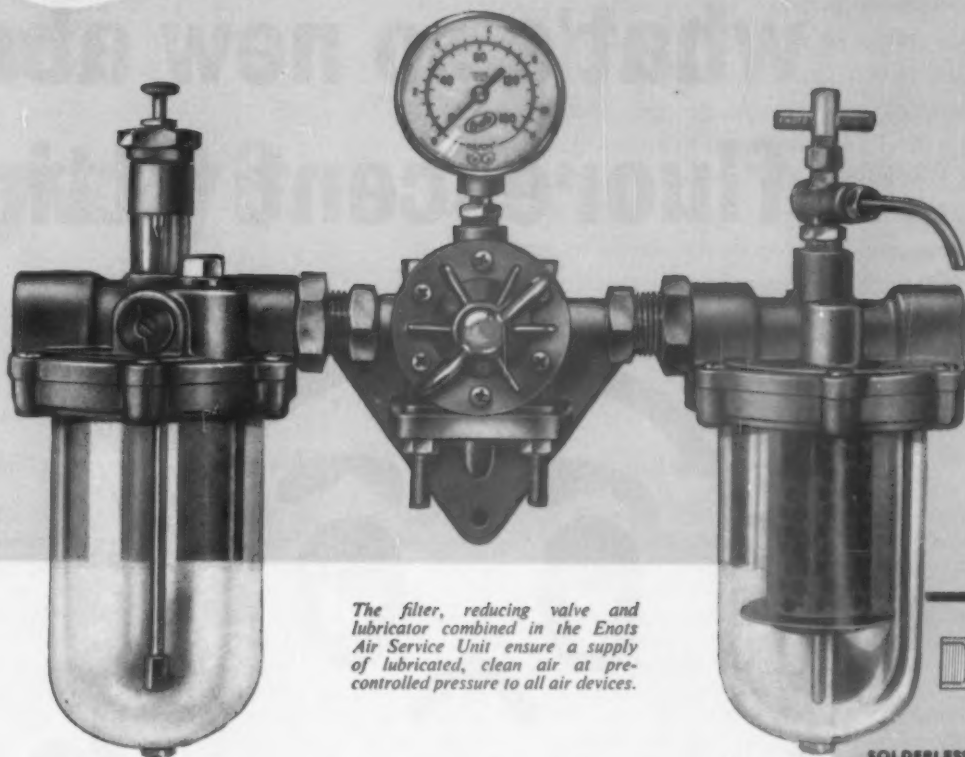
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Enots

AIR SERVICE UNITS and PNEUMATIC EQUIPMENT

improve efficiency and reduce production costs



The filter, reducing valve and lubricator combined in the Enots Air Service Unit ensure a supply of lubricated, clean air at pre-controlled pressure to all air devices.

A pressure reducing valve fitted to almost any pneumatic device will save its cost in a very short time by reducing air consumption. At how many points in your works are you using full line pressures of up to 100 lb. per sq. inch where 80, 60 or even lower pressures would be adequate? Savings are more or less in direct proportion to pressure reduction.

SOLDERLESS
UNIONS



BLOW HOSE
NOZZLE
VALVES



COPPER,
BUNDY STEEL
AND FLEXIBLE
TUBES



EXHAUST
SILENCERS



QUICK
COUPLINGS

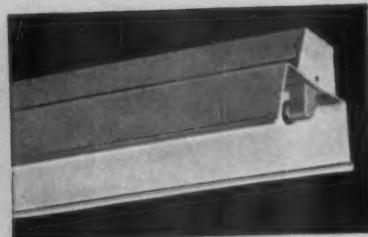
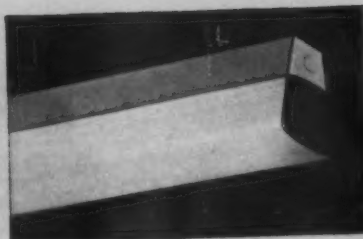
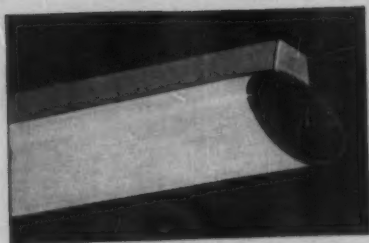


EJECTOR
VALVES

BENTON & STONE LTD.,

ASTON BROOK STREET, BIRMINGHAM 6, ENGLAND. Telephone: ASTon Cross 1905

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describing our Air
Service Units and
individual compo-
nents and other
catalogues on
Enots pneumatic
devices are avail-
able on request.

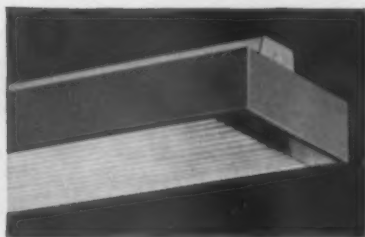
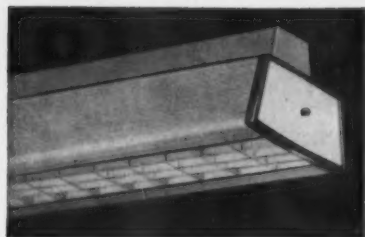


what's so new about fluorescent fittings



THE GENERAL ELECTRIC CO. LTD.

MAGNET HOUSE, KINGSWAY, LONDON, W.C.2.



these anyway?

Everything is new! The '101 Range' is an entirely new range of contemporary styled industrial, commercial and decorative fluorescent fittings. The successful result, in fact, of team work between G.E.C. fittings designers and illuminating engineers. Competitively priced—outstandingly modern in conception! NEW also is the introduction of basic channels for single or twin tubes, $1\frac{1}{2}$ ft. to 8 ft. which, with specially designed attachments, form an interchangeable system of great versatility with particularly simple installation and maintenance. It is important that you learn all about this exceptional range—the '101 Range'—of G.E.C. fluorescent fittings, so write for fully descriptive catalogue No. F 4068.

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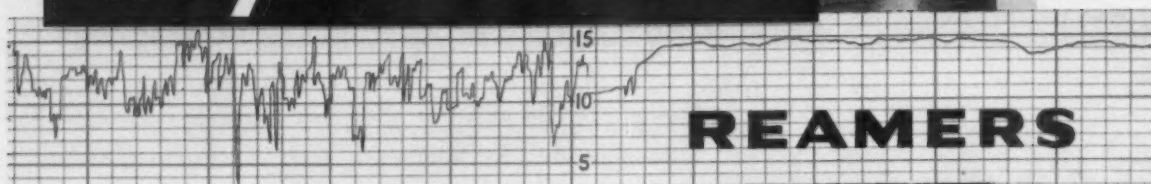


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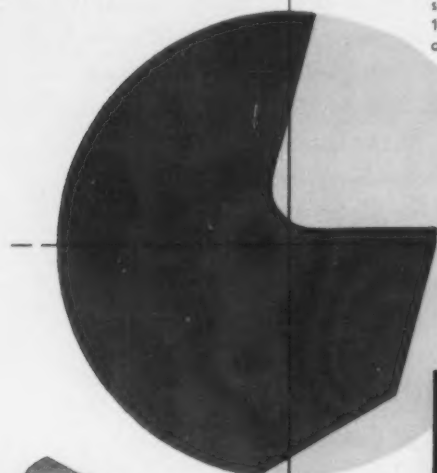
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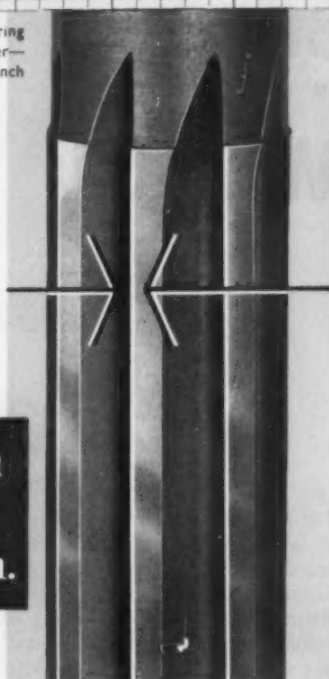


REAMERS

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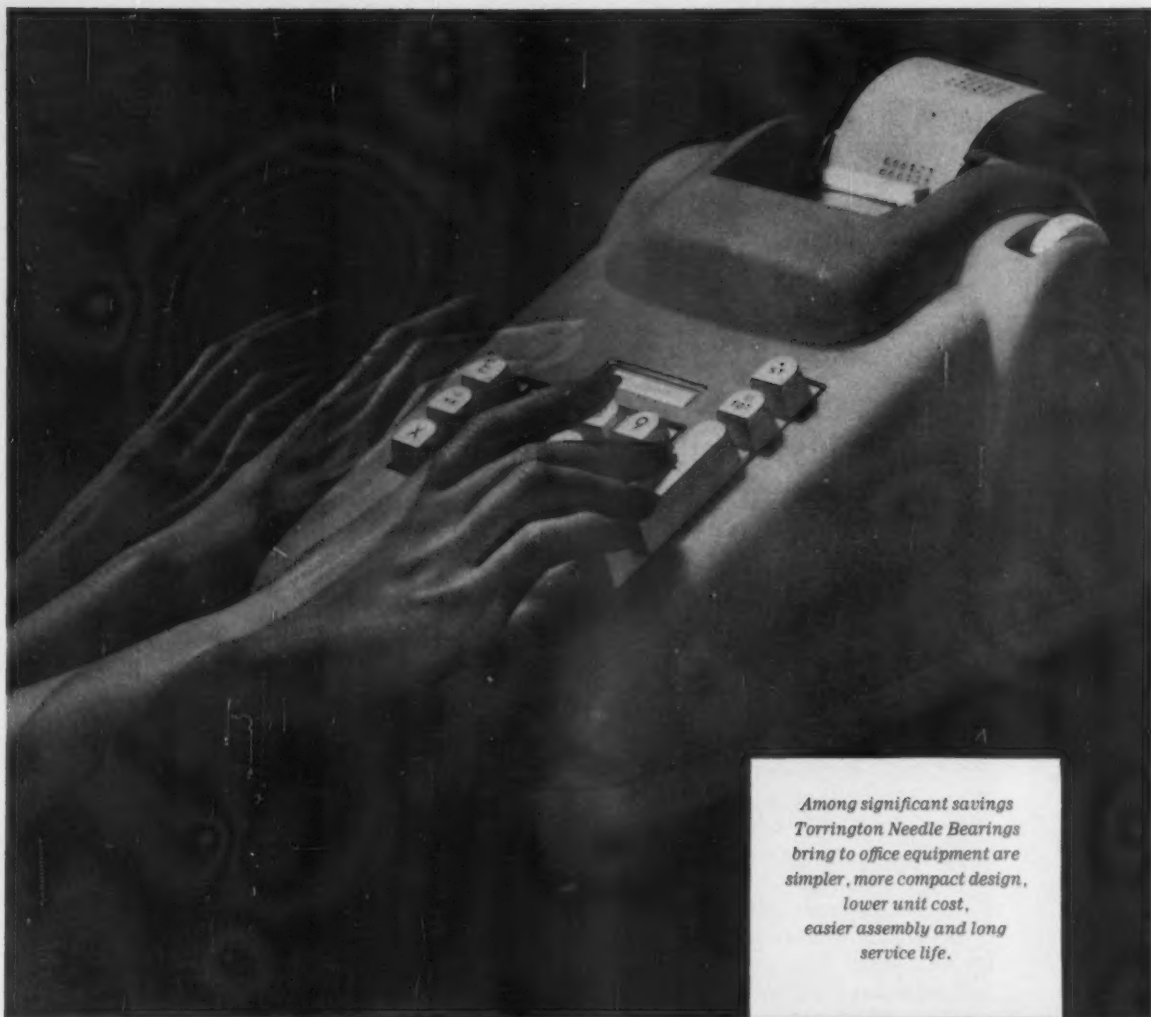
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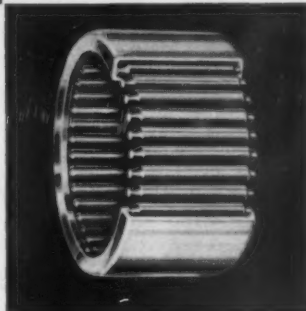
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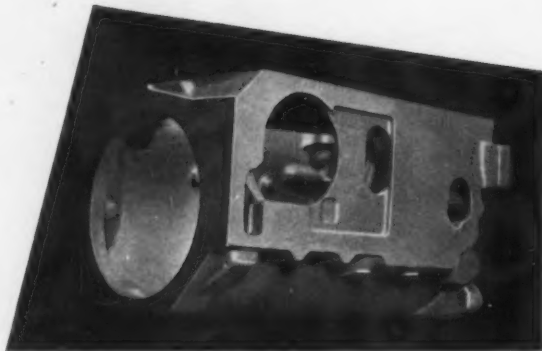
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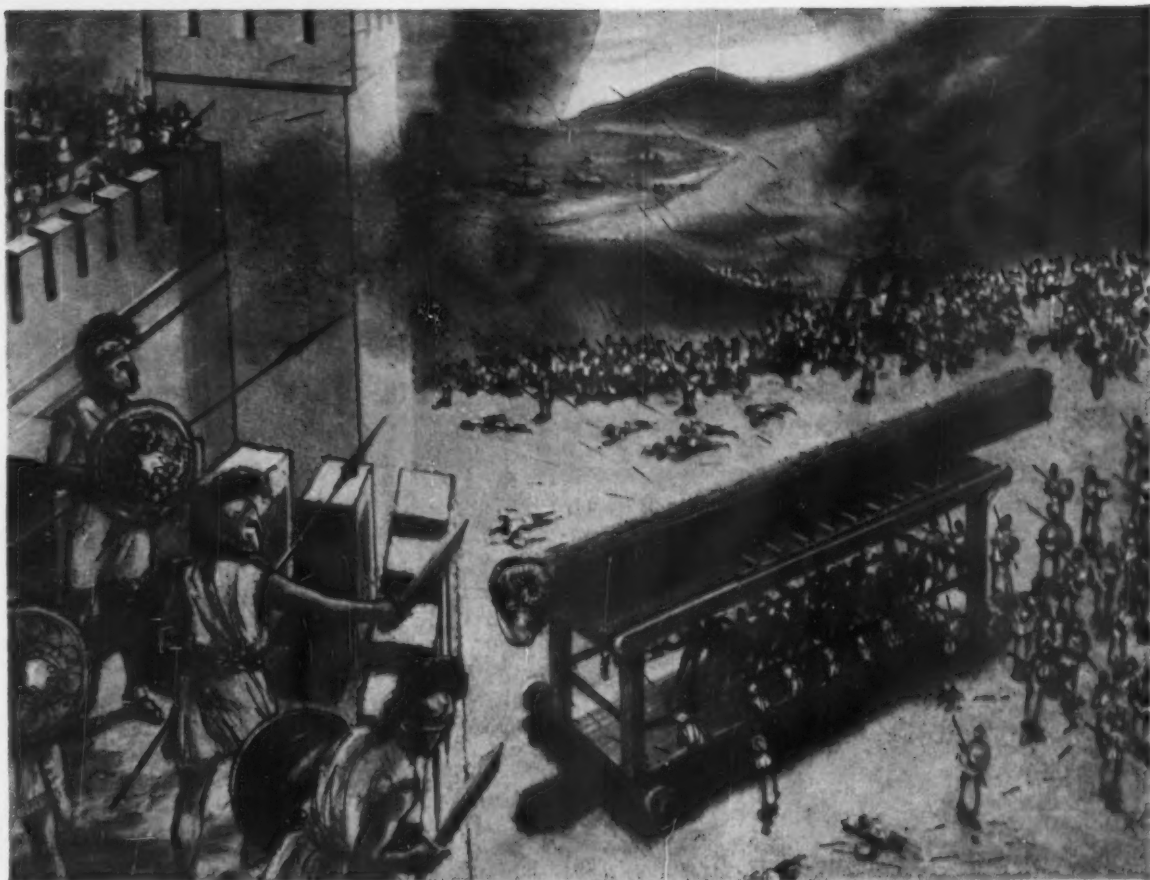


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DESIGN MATERIALS

AUTOMOBILE ENGINEER

PRODUCTION METHODS

WORKS EQUIPMENT

Production and Design

BBRITISH automobile manufacturers, and more particularly those dealing with passenger cars, have good reason for satisfaction. After the set-backs of 1956 and early 1957, they have, in the export markets, regained the position they held before the crises that threatened to have very serious, in fact almost disastrous, effects. Sales of British vehicles in the United States of America are now running at a level that would have been thought impossible only a few years ago, even by the most optimistic. What is happening in other export markets suggests that the worst of Continental competition has now been met and that ground lost earlier has now been regained.

The improvement is not, of course, due to any single cause. Naturally, the main factor is the general merit of the vehicles in relation to price. However, this in itself is not sufficient to sell vehicles in export markets. To it must be allied a positive selling policy and the best possible organization of service facilities. In the past there were very definite weaknesses in both these aspects of export trading, but there have been tremendous improvements in recent years. World tours and on-the-spot investigations by men from the industry have worked a transformation.

Although there is cause for satisfaction, there is no room for complacency. Serious thought must be given to the steps that are necessary to maintain and extend the position now held. On this matter there are two policies to be considered, short-term and long-term. Obviously, the short-term policy is to strive to maintain present price levels. The long-term policy is to decide and then follow the lines on which design development should take place.

In regard to price maintenance, the automobile manufacturer has direct control over only a relatively small percentage of total costs, not more than 30 per cent in the most fully integrated British factory and considerably less in others. This is not to suggest that a fully integrated factory would necessarily lead to cost reductions. In fact, the contrary might occur. One advantage the British automobile industry has over its Continental competitors is the ability to draw supplies from specialist manufacturers of components and equipment who are able to exploit the economies of large-scale production. It is the inescapable cost items, such as heavy taxes and the charges for services and goods supplied by the nationalized industries, that make the maintenance of competitive prices so difficult.

The costs that can be controlled by the automobile manufacturer are in great measure governed by the efficiency of the production equipment. During the past decade, and more particularly during the past five years, every major automobile manufacturer in this country has invested extremely large sums of money in improving production facilities. Exactly how much has been done is not generally realized—rather too much attention has been paid to talk of the millions of pounds that have been spent, and much too little to the results obtained from the expenditure.

Two examples may be quoted as typical of the progress that has been made. For one organization, comparison of output in 1939 with that of to-day shows that for less than 25 per cent increase in the labour force the output has increased by 250 per cent. In another, developments in the last five years have led to almost doubled output for a 50 per cent increase in labour force. Without any question the industry is highly efficient productively and is still receptive of new ideas.

Is there the same receptiveness to new ideas in design? A consideration of post-war vehicles suggests that the answer is, No. Except in body styling there has been little break from long-established practice. Improvement by modification rather than by innovation has characterized British post-war developments.

More than once, it has been stressed in these columns that quantity production must have the backing of a large home market. It is, therefore, fortunate that the mechanical developments that would tend to give British cars an even greater appeal in export markets would not in any way militate against their success in the home market. On the contrary, developments, in suspension systems, for example, which are advisable for the rough conditions met in many export markets would, although not essential, still be advantageous on cars to be used only in Britain.

Too sudden a break from established practice would, of course, be fraught with danger. A completely unconventional car might appeal to a very small class of motorists but would not, for some considerable time, meet with general acceptance. This, however, is no reason for slavish adherence to stereotyped practice. A little more of the spirit of adventure that has been shown in production engineering would not be amiss in design engineering.

Body Mounting

Some Notes on the Application of Rubber to Prevent the Transmission of Unduly Severe Loads and Vibration from the Chassis to the Body

DURING the post-war period, the substantial progress that has been made towards body weight reduction would scarcely have been possible, had it not been for improvements in mounting techniques. The main problem in both commercial vehicles and private cars is to allow adequate relative movement between the body and chassis frame, while considerations relating to vibration isolation and the prevention of transmission of noise to the body are of secondary importance. In general, vehicle bodies are stiff, but relatively weak locally by comparison with chassis frame members. Although a certain amount of distortion can be tolerated in the locality of the body mounting brackets, without trouble arising through overstressing, the amount of distortion permissible is generally appreciably less than that needed to accommodate frame deflections. Therefore, the interposition of flexible mountings between the body brackets and the frame is essential. Another factor that must be considered is fatigue. Although relatively small deflections of the chassis frame may not give rise to high stresses in the mounting brackets on the body, their repetition at high frequency is liable to cause failures.

The flexibility of the mountings must be limited for several reasons. One is that too much relative movement between the body and chassis may cause difficulties with regard to the controls. With a double-decker bus, unrestricted movement of the body would reduce stability to such an extent that the vehicle would not pass the regulation tilt test. So far as bodies that carry heavy loads are concerned, mountings designed to allow large relative deflections would be of impracticably large size.

Most private cars are, of course, of integral construction and therefore have no body mounting problems. With those that still have separate bodies and chassis, there are many conflicting design requirements. In this type of vehicle, the chassis frames are generally stiff by comparison with those of commercial vehicles. This means that the accommodation of the relative movement between the frame and the body is

not such a serious problem, but the isolation of vibration and noise is much more important. These requirements are fairly easy to meet, because the transmission of high frequency vibrations and noise can be prevented without using mountings giving large static deflections. However, the main difficulty arises because manufacturers, in their desire to reduce weight and thus to minimize prime cost and fuel consumption, have tended to use light frames and to rely on the body to take a share of the loads and to provide a substantial proportion of the overall stiffness of the vehicle. Inevitably, therefore, a compromise between the conflicting requirements has to be sought.

Although commercial vehicle manufacturers have also concentrated on weight reduction, the emphasis in this field has not been on a reduction in all-up weight. Rather has the aim been at keeping the vehicle weight to a minimum so that the pay load, and therefore operating efficiency, can be increased. This has meant that the greatest proportion of the weight saving has been effected in the body rather than in the chassis. Where aluminium is extensively employed, the low fatigue resistance of this material, by comparison with that of steel, makes it desirable that well designed mountings be employed. Also, the need to adopt unduly thick aluminium sections, to make good the deficiencies of this material in respect of strength and stiffness, can be obviated by good mounting techniques and due consideration with respect to the fundamentals of structural design.

Despite the fact that the accommodation of relative deflections is still a major factor so far as cab mounting is concerned, vibration isolation and noise insulation are becoming increasingly important, and are likely to continue to do so. If the currently projected European Free Trade Area, or Common Market Agreement, are brought into force, British manufacturers inevitably will become even more interested in the European market than they are at present. This means that a higher proportion of chassis will be delivered complete with cabs to the Continent, where great emphasis is placed on crew



This tanker, by Aluminium Schweisswerk A.G., of Schlieren, Zurich, is mounted on two bushes at the front and a pair of rubber sandwich units at the rear. The bushes are arranged on each side, with their axes transversely in line to provide positive fore and aft location, and the V-type layout has been adopted for the sandwich units to give satisfactory lateral location, while at the same time providing for the necessary tolerance on the dimension between the fronts and rear mounting points

comfort. The reason why crew comfort is regarded as such an important factor there is that journeys are so much longer and mean cruising speeds are higher than in this country. Both these factors call for the utmost endeavours to minimize driver fatigue and thus to avoid accidents.

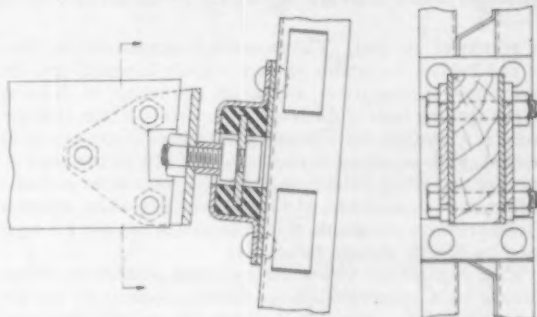
Unduly soft mounting arrangements have to be avoided, not only because of the control problems already mentioned, but also for psychological and physiological reasons. These factors affect both cab and passenger car design. Large relative movements between body and chassis tend to give the occupants a feeling of insecurity, which is generally interpreted as an unsatisfactory ride. They may also lead to travel sickness. Moreover, if the driver is completely isolated from chassis movement, he tends to lose the feel of the vehicle, and his reactions, as applied to the controls, are less certain and precise. Too much body sway might lead to instability of the vehicle, particularly in the case of load-carrying bodies, such as tanks, for the transport of liquids in bulk.

In practice, most of the problems met on any type of vehicle can be solved in the following manner. The mountings should be designed to give ample flexibility over a strictly limited range of movement, beyond which the stiffness increases progressively and rapidly. The thickness of rubber used has to be adequate to give insulation so far as both noise and high frequency vibrations are concerned. Other requirements for mounting units are compactness and simplicity both of manufacture and of assembly. The arrangement of the entire mounting installation is an important factor: the positions of the individual mounting units must be, on the

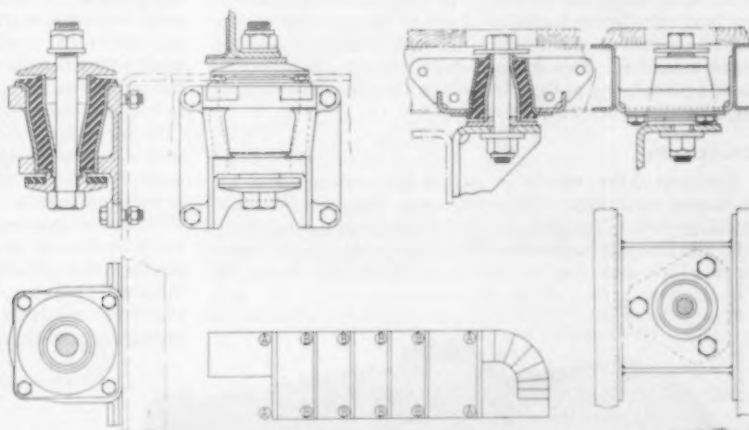
what one would expect in this country.

The softer the vehicle suspension, the smaller are the frame deflections likely to be experienced. Therefore, the current trend towards the use of air suspension for certain types of vehicles will undoubtedly simplify body mounting problems. Currently, body mounting brackets are most liable to be damaged when the vehicle is running empty. This is because, in this condition, the natural frequency of the suspension system is high and so therefore are the vertical accelerations.

Frame deflection characteristics and modes vary enormously from vehicle to vehicle. For example, the frames of tankers in which the tank is fairly rigidly attached at four or more points to the chassis do not deflect much over the length of the tank, so nearly all the movement takes place under the



Above: The Metalastik F.S. type mounting, for the connections between floor bearers and side pillars on buses, allows for relative angular deflection between the two components



Right: Typical layout of Metacone mountings applied to a double-decker bus body. The mounting illustrated in the three views on the right is installed at points B and that in the three views on the left is applied at points A in the floor plan diagram of the vehicle

one hand, such that the deflection that can be obtained with them is fully used and, on the other, that the units are not overstrained.

Frame deflections

Although mountings are, in general, designed to accommodate frame deflections, the amount of deflection of the frame also tends to be restricted by the mountings. In other words, under extreme conditions, the stiffness of the body and its mountings is added to that of the frame itself. There seems to be little information available as to the amount of deflection likely to be experienced in service.

However, some figures are given in an article by Dr-Ing. Karl Erz¹. For example, for an unsprung tractor he quotes a frame twist of ± 25 deg and wheel deflections of ± 52.8 cm from the normal ground level. In addition he quotes the following maximum wheel deflection above ground level, that is, the height of the obstacle traversed: for passenger cars ± 20 cm, for commercial vehicles and trailers ± 30 cm, and for cross country vehicles ± 50 cm. Most of these figures appear to be rather high by comparison with

cab. In many instances, the tanks are so mounted that the frame is entirely free to deflect naturally over the whole of its length. Drop-side trucks, on the other hand, tend to be stiffer in the region of the cab and relatively free under the body, or load platform. In private cars, most of which have stiff box section frames, the deflections are relatively small.

Public service vehicles

In this country, bus and coach bodies are generally rigidly attached to their chassis, because they take a relatively high proportion of the operating loads and contribute in large measure to the total stiffness. Moreover, integral construction is being increasingly used for this type of vehicle. In overseas countries, however, where public service vehicles frequently have to traverse exceptionally rough roads, and therefore frame deflections are much greater than in this country, rubber mountings may be required.

Patent No. 583,046, filed by Metalastik Ltd., of Leicester, shows an arrangement in which stiff mountings are employed on each side of the chassis, midway between the ends of the body or in the transverse vertical plane containing the centre

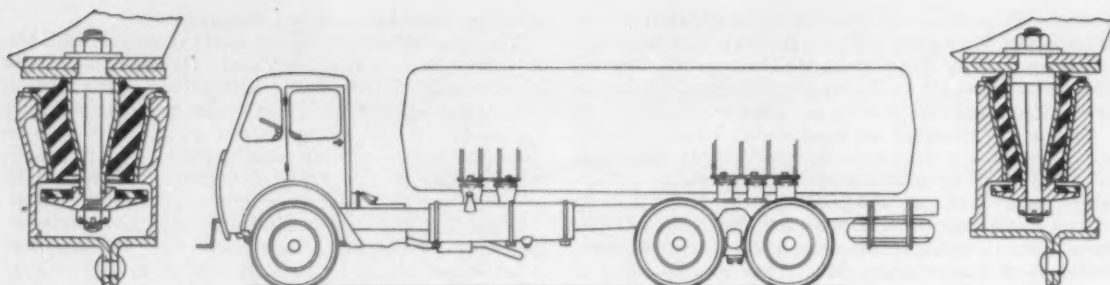


Diagram of a ten-point mounting arrangement for a heavy tank. Of the two types of Metacone mountings used, that employed at the four front installation points is shown to a large scale on the left, and the other, used at the six rear points, is illustrated to the same scale on the right

of gravity of the load. The mountings immediately in front of and behind the centre pair are slightly less stiff, and the next ones are even softer, and so on, the softest of all being at the extreme ends of the body. The object of this arrangement is to provide for maximum deflection where it is most needed, while obtaining the necessary stability by the employment of the stiffest mountings at a nodal point so far as frame deflection is concerned. However, for the reasons outlined in the previous paragraph, the arrangement has not yet been used by British manufacturers.

With double-deck buses, the mounting problem is, as has already been mentioned, most difficult because of the tilt test requirements. Rigid connections are generally employed between the frame and the body. In some instances, however, the relatively lightly loaded platform at the rear end is supported on rubber mountings interposed between it and the frame extension. This arrangement allows relative deflection to take place freely at the point where adequate provision for such deflection is most needed.

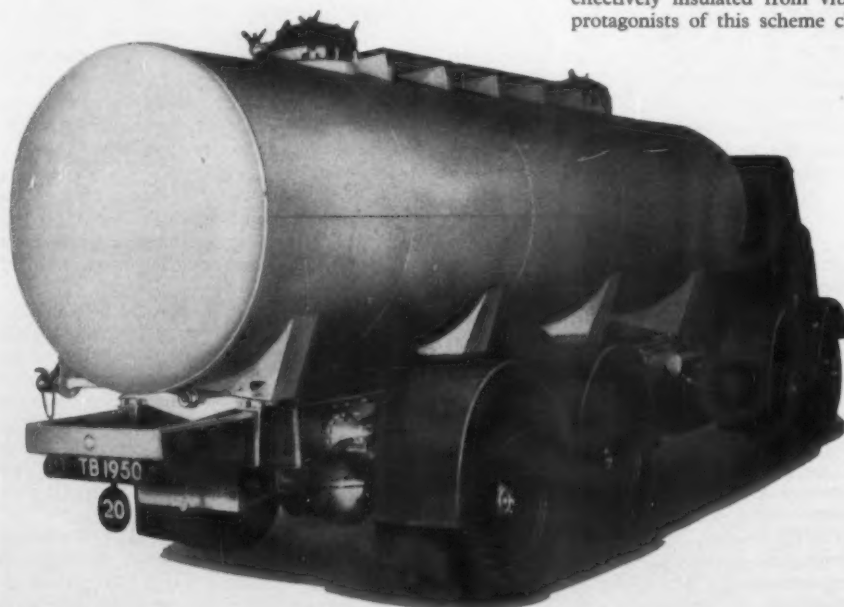
Truck cabs

Opinions differ widely as to the best arrangement for mounting truck cabs. However, many designers feel that, in the interests of stability, it is best to have a pair of relatively stiff mountings, one on each side of the body, in one transverse plane, and that all the other mountings should be

flexible to allow for relative movement due to frame weaving. Some manufacturers place a pair of rigid mountings under the scuttle and, according to the length of the cab, have either two more pairs of flexible mountings, one at the front and one at the rear, or a single pair at the rear. The flexible mountings in each pair are in some instances spaced widely apart and therefore are designed to cater for fairly large deflections. In other instances, they are arranged relatively closely together, so that less expensive mounting units allowing smaller deflections can be employed. An alternative is, in effect, to bring the mountings together, by employing a single-point mounting, which acts as a pivot.

The actual arrangement used depends on the application. For example, if the cab structure is relatively stiff, a single-point mounting at the rear, in conjunction with rigid mountings under the scuttle, might be adequate. On the other hand, with a flexible cab, this arrangement might not be stable enough. Also, the loading in some instances may be too great to be taken conveniently by a single mounting unit.

In some designs, the rigid mountings are placed one on each side, under the seats, on the principle that the driver needs to be firmly seated above the base-plate on the chassis, to avoid differential movement between him and his controls. With this arrangement, the driver is insulated from vibration solely by the seat and squab cushions. Other manufacturers maintain that the arrangement of the rigid mountings under the scuttle is better, since the driver's seat can then be more effectively insulated from vibrations of the chassis. The protagonists of this scheme claim that the seat and squab



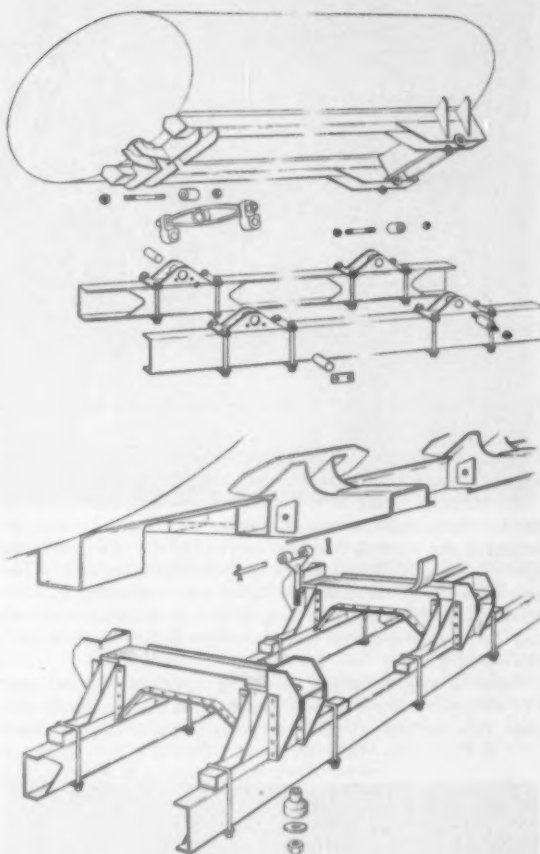
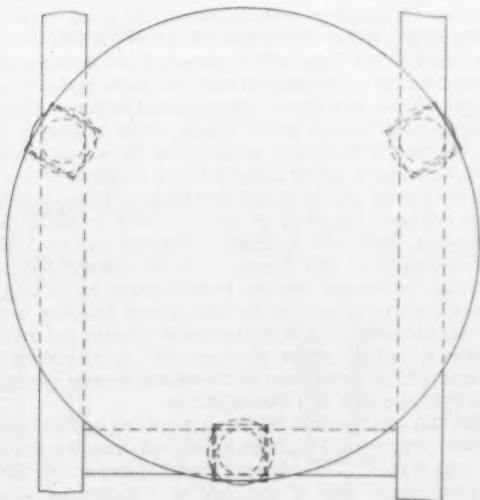
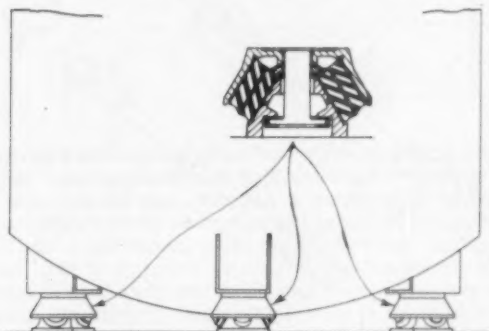
This tank, made by Thompson Bros. (Bilston) Ltd., has four mounting stations along its length. Torsional stability is maintained at the two intermediate stations, while the end ones are centrally pivoted to allow for relative torsional deflection between the chassis frame and the tank

cushions alone cannot be expected to provide all the insulation required.

For rigid mountings, a pair of metal bushes and pins, with their axes arranged horizontally in line in a transverse vertical plane, are sometimes employed. In other instances, rubber bushes are used instead of metal ones. With this latter arrangement, the rubber section is generally relatively thin, so that vertical, and fore and aft deflections are strictly limited. If flanged rubber bushes are employed, lateral deflections also can be well controlled. The positioning of the axes horizontally in a transverse plane allows for angular deflection of the frame side members relative to the axes of the bushes. The advantage of employing rubber bushes is, of course, that problems, such as fretting fatigue, lubrication in service, and squeaking, do not arise. Stiff mountings of other forms, for example Metacones, installed with their axes vertical, can also be used for this purpose.

A wide range of flexible mountings is available for application to the other points under cabs: these are described in some detail later. They can be either of the sandwich form or of the conical or plain bush types. In some applications, the pairs are arranged in such a way that the principal axis of deflection of each component is aligned with a point mid-way between the frame side members, which is approximately on the longitudinal axis of flexure of the frame, so that the body is free to deflect about this axis. At the same time, with this

Mounting arrangement for a vertical, cylindrical, cement tank. Three Cushymounts, which are of the form shown to a larger scale at the top of the illustration are employed to accommodate vertical movement of the frame and to provide positive location horizontally



Top Above: This three-point mounting layout for tankers of up to 12,000 litres capacity was introduced in 1949 by Aluminium Française

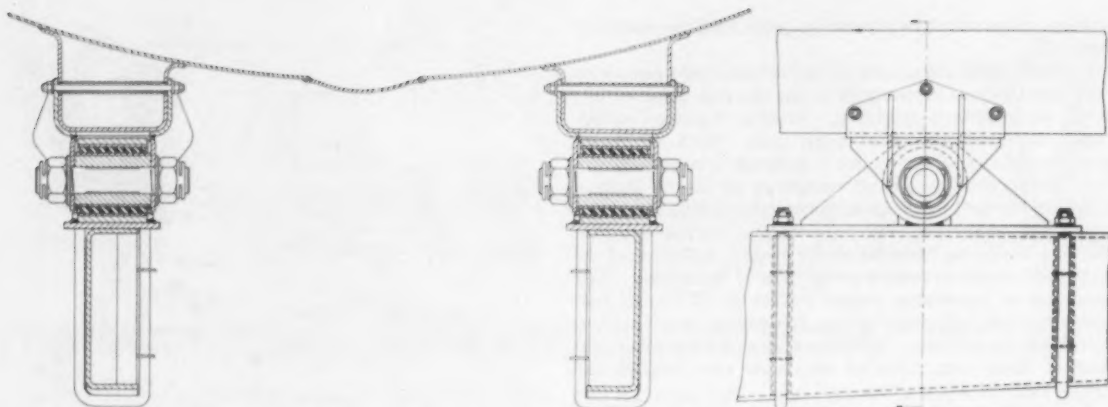
Above: A four-point mounting arrangement, for tanks of large capacity, designed by the Service Technique d'Aluminium Française, in conjunction with Etablissements Pradère, of Talence, France

arrangement, the stiffness in the lateral and vertical directions is adequate to give stability. If the torsional stiffness of the cab is low, it may be necessary to employ mountings in such a manner that their principal axes of deflection are widely spaced, to prevent torsional instability.

Tanker vehicles

Even when tanks of conventional materials are employed, the mounting problems are difficult, because of the racking stresses liable to be encountered owing to frame deflections. When aluminium or plastics materials are used in the construction of the tank, the problem is even more acute. The number of mounting points required and their actual layout depends largely on the weight and nature of the tank and the liquid it contains. Some manufacturers consider that tanks whose capacity is more than about 2,600 gallons require a four-point mounting. In some instances, an even larger number of mountings is employed.

A wide variety of combinations of types of mountings has been used. For example, all four can be simple sandwich type units, one pair being at the front and the other pair at the rear. A V-type layout, as viewed from the ends, can be used to provide for lateral location, while a similar inclination of the units as viewed in side elevation can cater for



The rear bearer arrangement for the aluminium alloy tank designed by Thompson Bros. (Biltson) Ltd., incorporates two rubber bushes, one on each side

longitudinal location. Alternatively stops or tie rods can be used to prevent undue movement in any horizontal direction.

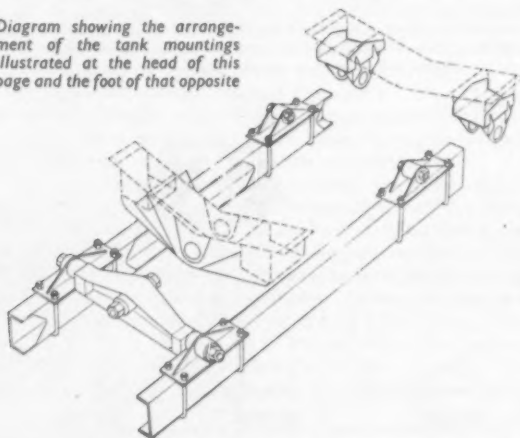
For smaller tanks, it is generally considered desirable to use the three-point mounting system. Two of the points are arranged one on each side near one end of the tank, while the third is mid-way between the sides at the other end. The pair of points at one end provide for torsional stability, while the single point is simply a support about which the assembly can pivot as the frame side members deflect differentially relative to it.

Again, a wide variety of mounting types can be employed. For example, simple conical rubber units can be fitted, with their axes vertical, at all three points, as also can sandwich

type mountings. The advantage of the conical type units is that location against movement in any direction in the horizontal plane is easily effected.

An alternative is to employ plain or flanged bushes with their axes in the horizontal plane. In one practical arrangement of this type, there are two bushes, one on each side at the rear, placed with their axes transversely in line. The

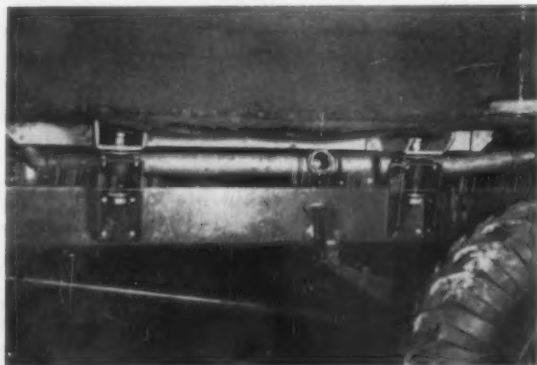
Diagram showing the arrangement of the tank mountings illustrated at the head of this page and the foot of that opposite



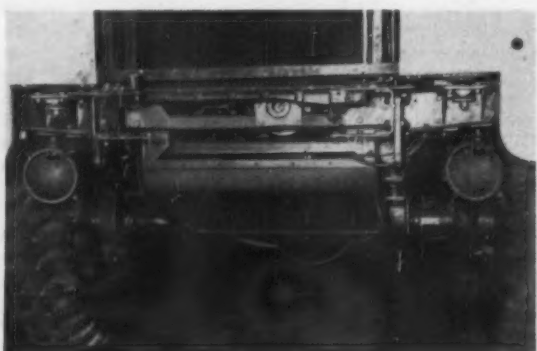
third bush is near the front end of the tank, mid-way between the frame side members, with its axis parallel to the longitudinal axis of the vehicle. The two bushes at the rear provide for location in the longitudinal direction and accommodate relative bending deflections between the frame and the tank, while that at the front gives positive lateral location and allows for torsional deflection of the chassis frame relative to the tank. If flanged bushes are employed at the rear, these, too, can be arranged to afford positive lateral location.

An accompanying illustration shows a three-point mounting layout designed for tanks of up to 12,000 litres by S.A. Aluminium Française² in 1949. Although rubber bushes were employed in this design, it would appear that dry-lubricated or simple bronze bushes could be employed, because the arrangement of the links is such that they would accommodate variations in the distances between the mounting points, such as might be occasioned by manufacturing tolerances, frame deflections, or differential thermal expansion as between the tank and chassis frame.

With this arrangement, there is a mounting on each side at the rear, comprising a T-shape fitting with a rubber bush on each arm of the T. The arms of each T-piece are parallel to the longitudinal axis of the vehicle. A circular rubber



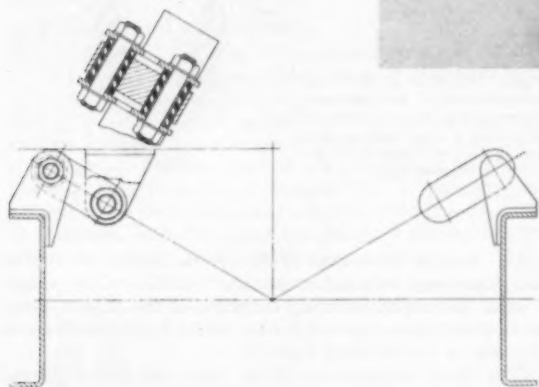
Above and below are shown details of the mountings for the tank and the front end of the cab of the Tecalemit Foamite, dual-purpose crash tender



Right: Of the eight mounting points that can be seen on this Foamite crash tender chassis, the rear four are for the tank and the other four are for the cab. There are two more mountings for the cab, and these are illustrated at the foot of the opposite page



Below: If the tank is too heavy to be supported at one end on a single-point mounting, inclined links can be employed, as shown here, to give the required roll centre

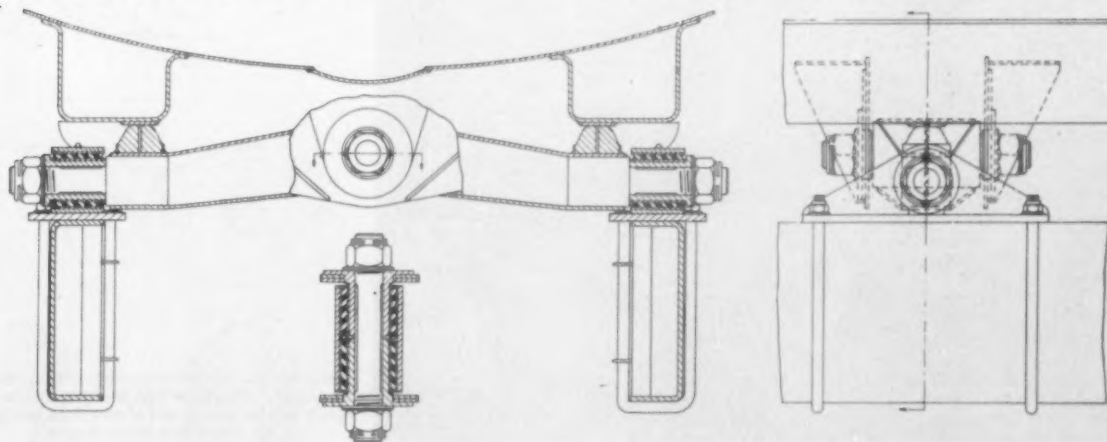


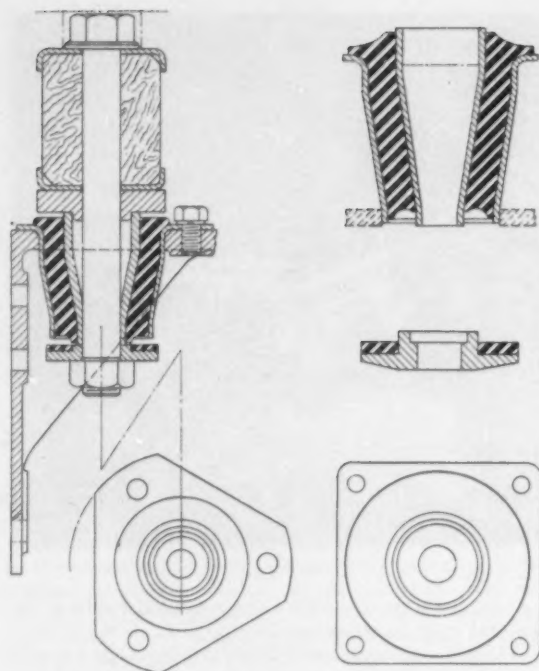
mounting secures the leg of the T to the chassis frame, while the two bushes on the arms of the T are carried by a bracket on the tank. At the front, the tank is connected by a single rubber-bushed pivot, also with its axis parallel to the longitudinal axis of the vehicle, to the centre of a yoke. Each end of this yoke is connected by a rubber-bushed shackle to a bracket below it on the frame. The axes of the bushes in the shackles are arranged transversely relative to the vehicle, to accommodate variations in length due to frame deflections and the other factors already mentioned.

If the load is too heavy for a single mounting point at the front, the tank can be mounted at this position by means of two shackles, one on each side, geometrically arranged in such a way that the instantaneous centre of rotation of the tank relative to the chassis is, for example, mid-way between the frame side members. A layout designed, by Metalastik Ltd., for this type of application is shown in an accompanying illustration. This arrangement can also be used for cab mounting, but is probably more expensive than most of the simpler types of mounting currently used.

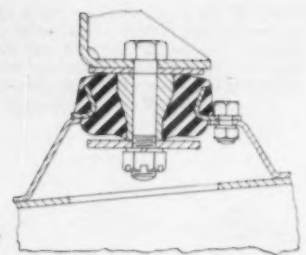
An interesting mounting arrangement for a large tank is that employed on a vehicle manufactured by Thompson Bros. (Bilston) Ltd., which is shown in an accompanying illustration. This tank, of stainless or mild steel, is welded on four cradles, or cross bearers. The ends of the two intermediate cross bearers are attached to the chassis frame side members by means of relatively stiff rubber bush type mountings with their axes transversely in line. On the other hand, the front and rear cross bearers are each pivoted in a single rubber bush, with its axis arranged longitudinally. The bush is at the centre of a yoke, the ends of which are carried in rubber-bushed trunnions, with their axes transversely in line. These trunnions are mounted on the frame side members. In other

Arrangement of the front bearer of the tanker recently introduced by Thompson Bros. (Bilston) Ltd.; the other details are illustrated opposite

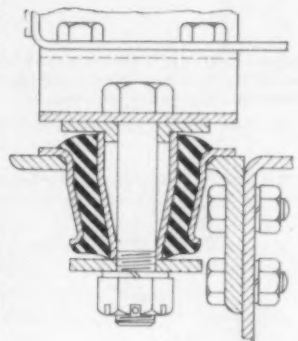




Right: This Metacone mounting has integral rubber end-buffers, which form the bump and rebound stops



Left: Two different types of Metacone mountings. That shown assembled to a bracket is applied to a bus body. The other, which is also suitable for bus bodies, has its upper end profiled to give a more progressive bump stop characteristic



Right: The ends of the outer conical sleeve of this Metacone mounting are lipped, or flanged, to provide a large backing area for the integral rubber bump and rebound stops

words, this tank is relatively rigidly supported at its centre, while the ends are pivoted about both the longitudinal and lateral axes to allow for torsional deflection of the frame.

Thompson Bros. have also introduced, more recently, a tanker of 2,400 gallon capacity, which has a three-point mounting. The arrangement of the mountings relative to the tank structure and chassis frame is of considerable interest. Four pressed box-section members, or longerons, extend the full length of the tank, two on top and two below. They are welded to the tank shell and are spaced apart by the transverse bulkheads, or baffles, as well as by intercostal members. The intercostals extend vertically between the upper and lower longerons on each side, and thus form deep shear-webs of beams, the booms of which are the longerons already mentioned.

This whole assembly is a good example of sound structural design, since the tank shell is subjected only to stresses arising directly from its liquid load, and therefore is relatively

light. Another advantage of this system is that, because of the three-point arrangement and the flexibility of the bushes, a small amount of lozenge deflection of the chassis frame, as viewed in plan, can be tolerated without adverse effects on the tank or its mounting brackets.

The detail arrangement of the mounting points for this tank is shown in the accompanying illustrations. At the rear, there are two rubber bushed pivot mountings, with their axes transversely in line. A single-point mounting, comprising a rubber bushed pivot with its axis arranged longitudinally, is housed at the centre of a yoke at the front. The ends of this yoke are carried in rubber bushes, trunnion-mounted on the chassis frame side members, as in the other vehicle.

Crash and fire tenders used on aerodromes are special forms of tankers. High speed potential over rough country, and the capacity to carry an ample supply of extinguishing fluid, in addition to the equipment normally carried on fire engines, are essential characteristics of this type of vehicle.



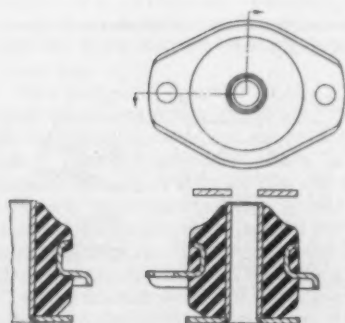
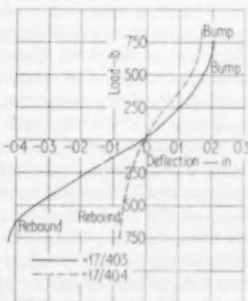
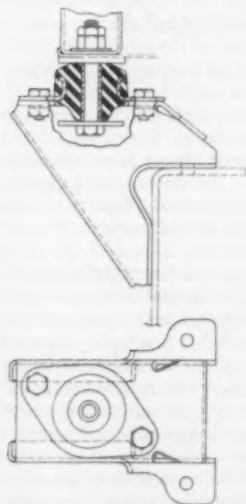
Metacone anti-vibration mountings are carried on brackets adjacent to both ends of each rear spring and the trailing end of each front spring of the Dennis ambulance chassis

Since speeds in excess of 60 m.p.h. over rough terrain are not uncommon, the vehicle has to be designed to withstand severe racking stresses and shocks. These loads are imposed not only on the tank, but also on the cab, and the crew may be subjected to severe buffeting unless the flexible mountings are adequate.

An example of this type of fire engine is the Foamite dual-purpose crash tender, manufactured by Tecalemit Ltd., of Plymouth. From the illustrations of the mounting arrangements of this tender, it can be seen that six Metalastik Metacone mountings are employed for the cab and four for the 700 gallon tank. These mountings are arranged in pairs, more or less symmetrically disposed about the longitudinal centre-line of the chassis. There are two at the extreme front end of the cab, two at an intermediate position under the floor, and two more to support the extreme rear end of the cab. The other four mountings are arranged more or less symmetrically about the centre of the tank, as viewed in plan. They are carried on the frame side members and an underframe that supports the tank is bolted down on to them.

Ambulances and private cars

In private cars, the principal requirements are as follows: the unit must be flexible over a small range of movement from the mean position, so that road noises and vibrations are adequately isolated from the body. However, the deflection must be limited so as not to interfere with the feel or accuracy of the controls and also to avoid any sensation of instability. The mounting must be so designed that it maintains the location of the body accurately relative to the chassis under all conditions, including when the chassis is distorted as the vehicle moves over exceptionally rough terrain.



Left: A Controlled Rebound mounting for heavy-duty applications

The mountings are generally placed under the principal loading positions, that is, one on each side under the scuttle, another pair adjacent to the front seats, and a third pair under each end of the heelboard. Additional mounting units are usually fitted on each side under the boot floor, and towards the extreme front end of the vehicle.

With ambulances, space restrictions are not generally so severe, and softer mountings are desirable. An accompanying illustration shows the Dennis ambulance chassis, on which eight mountings are employed. On each side, three of these mountings are on brackets on the frame side members. They are arranged one adjacent to each rear-spring hanger bracket and one above the trailing end of the front spring. The other two are one on each side at the extreme front end.

Mounting units and details

The Metacone mountings are among those manufactured by Metalastik Ltd. for body mounting, as well as for other applications. As can be seen from the accompanying illustrations, these units are designed so that axial loads are taken in compression and shear, while radial loads are taken almost entirely in compression. Thus, if they are mounted with their axes vertical, they give ample freedom for vertical deflection of the frame relative to the body, while at the same time they provide adequate location against movement in all directions in the horizontal plane. Should extra flexibility be required in any particular direction in the horizontal plane, this can be obtained by employing slotted Metacone mountings. In these, the rubber is slotted on one side, or on radially opposite sides of the unit, to reduce the stiffness in the radial plane that contains the slots.

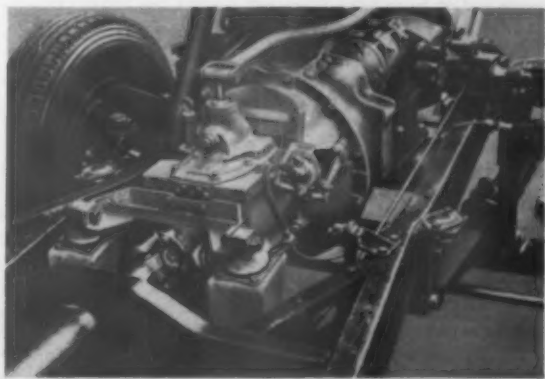
Metacone units have been used for bus body mountings.

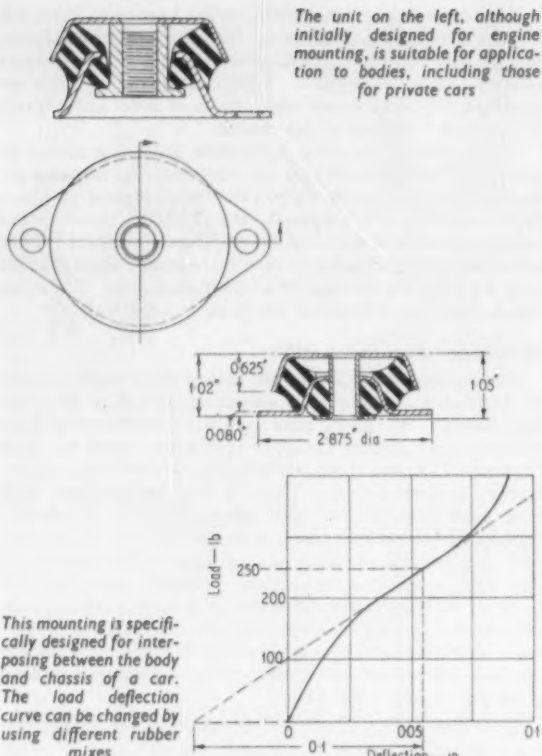
Right: Foamite crash tender cab floor plates removed to show the intermediate flexible cab mountings



Left: Controlled rebound mounting and typical characteristic curve

Below: This illustration of the front end of the Dennis ambulance chassis shows details of two of the body mounting arrangements





In one application, the cupped housing of the unit is flanged at its upper end and seats in a hole in the mounting bracket on the chassis frame. The inner conical steel sleeve has an overload washer spigoted into its upper end. This washer forms the seat for the body cross bearer, and the whole assembly is retained by a $\frac{1}{2}$ in diameter bolt passed through from the top. The nut is tightened against a rebound washer, which it pulls up against the lower end of the inner conical sleeve. The top of this washer is faced with rubber. Under rebound conditions, the rubber facing comes up against the lower end of the cup component and thus forms a stop. If the bump load is excessive, the overload washer comes down on the rubber at the top of the unit, again limiting the deflection.

Rebound loads can be very severe, particularly when the vehicle is travelling in the empty condition. Therefore, in some designs an additional support plate is fitted round the lower end of the cup component. This support plate is rigidly attached to the mounting bracket on the chassis frame and its function is to provide a relatively large area against which the rebound stop can bear. Alternative mounting arrangements are illustrated, in which the Metacone units are mounted the other way up.

In Metacone mountings of later design, the rubber stops are incorporated in the ends of the conical units, so that there is no need for rubber facings on the limit washers. In these later mountings, the ends of the outer sleeve, or cup component, are generally lipped or flanged and the rubber extends beyond these ends and over the lipped or flanged portions. Thus, when the limit stops come up against the rubber, it is compressed between metal surfaces of relatively large area.

A further development from this type of mounting is the Controlled Rebound, or CR, type of unit. This is a plain cylindrical bush type mounting with an inner and an outer metal sleeve between which is bonded the rubber. Both ends of the outer sleeve are lipped, or flanged, and the rubber is extended out over them to form the rebound cushions. The

inner sleeve, which is longer than the outer one, is expanded during manufacture to compress the rubber. This precompression increases the load-carrying capacity of the unit and greatly improves its fatigue resistance. As can be seen from the accompanying illustration, the rubber ends are designed in such a way that under both the bump and particularly the rebound conditions the limiting action of the stops is progressively increased with deflection. Hence the name Controlled Rebound mounting, which has been given to these units. In another form of CR mounting the rubber sections are larger, particularly at the ends, and the edges of the attachment-flanges are lipped to give them extra strength and stiffness.

The important features of the CR cab mountings are that over a limited range of movement, the loads are taken in shear instead of in compression and shear, as in the Metacone units. This means that over a large proportion of the effective working range, the mountings are very flexible. However, the deflections are positively and progressively limited by the bump and rebound stops.

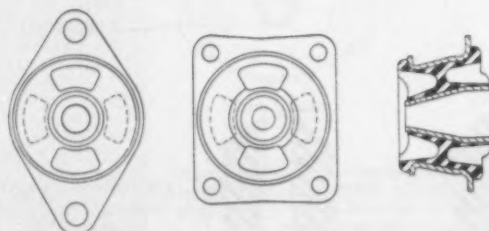
It is of interest to note that because of the progressive action of these stops, relatively small diameter bolts can be employed to hold down the flanges of the units. For example, two $\frac{1}{2}$ in diameter bolts are generally adequate, and the central bolt is generally of the order of $\frac{1}{4}$ in diameter. It is recommended that the nuts be locked with split pins, because of the severe buffeting and vibrational loads generally encountered. Another recommendation is that the limiting washers should be a close fit round their retainer bolts; otherwise, under severe loading, it is possible for the inner sleeve of the bush to be forced into the bore of the washer.

Two different types of mounting suitable for private car bodies are illustrated. They differ mainly in the detail arrangement of the rubber between the metal components. In both, the rebound rubbers operate more in compression than in shear, while the reverse is true of the rubber that takes the bump loads. This is because the suspension characteristics and ratio of laden to unladen weight in private cars is such that the insulation against bump loads is more important than against rebound loads. So far as lateral loading is concerned, the rubber tends to operate more in compression than in shear, so in this respect the unit gives adequate location of the body relative to the chassis. Both types are suitable for body mounting because of their relatively small height, which is of the order of 1-1 $\frac{1}{2}$ in.

The design and attachment of brackets for body mounting units is important. In the first place, if the loading is heavy, it is generally essential to attach the brackets to the vertical faces of the frame members, so that this loading is taken off by these faces in shear. If the brackets are mounted on the flanges the loading is taken in tension and compression, and the flanges are therefore alternately bent up and down by the reversals of vertical load. This is almost bound to cause fatigue failure.

When the brackets are bolted to the vertical faces, the offset of the centre of the mounting unit from the vertical face should be as small as possible. If the offset is large, the couple, due

Slotted Metacone mountings can be employed where extra flexibility is required in directions perpendicular to the principal axis of the cone



to the load acting at this offset distance from the vertical face, will cause differential loading of the bolts or welds that secure the bracket to the face, and will therefore place these fixings in tension and compression as well as in shear. Again, these conditions are liable to lead to fatigue failures. If it is impossible to avoid a large offset, it may be necessary to complicate the bracket by arranging for its attachment to both flanges as well as to the vertical face, so that the differential loads due to the applied couple can be taken off by shear to the flanges.

The flanges on the brackets should be as close as practicable to the edges of the rubber mounting units. If they are not, and the mountings are fixed in the centre of a relatively large area of flat sheet, vertical loadings will tend to cause diaphragm-like deflections of this sheet, and will lead to the development of fatigue cracks round the mounting unit. For the same reason, mounting points on cabs and bodies should be adequately supported by flanges, webs, or other devices close to the fixing points.

So far as mounting arrangements in general are concerned, there is great need for more data that can be applied at the drawing board stage to avoid waste of time and money on subsequent development work. A knowledge of the vertical and horizontal accelerations, and therefore loads, applied to body mountings, with particular reference to the circumstances in which they are applied, would be most useful. Research is also needed to determine the magnitude of frame deflections experienced under different conditions and with various types of vehicle. Finally, when this information has been obtained and classified in a logical way, further development could be usefully carried out to determine the most

Mounting brackets should be secured to the vertical face of the frame member, as in this example on the Foamite crash tender



desirable characteristics for mountings in different types of application.

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2. P. VIDAL: "Problèmes Soulevés par l'Etude et la Construction des Citernes en Alliage Léger," *Journ. S.I.A.*, February, 1957.

Excess Fuel Device for Diesel Engines

A Mechanism to Prevent Excess Fuel From Being Obtained Under Normal Running Conditions

A NOVEL unit for restricting the conditions under which excess fuel can be obtained with injection equipment has recently been introduced by Simms Motor Units Ltd., of East Finchley, London, N.2. In fact, this device restricts operation of the excess fuel device, so that it can be used only when the engine is started. It would be difficult for the driver to tamper with the mechanism in such a way that a rich mixture could be obtained under any other conditions. This, of course, has an important bearing on the problem of smoky exhaust.

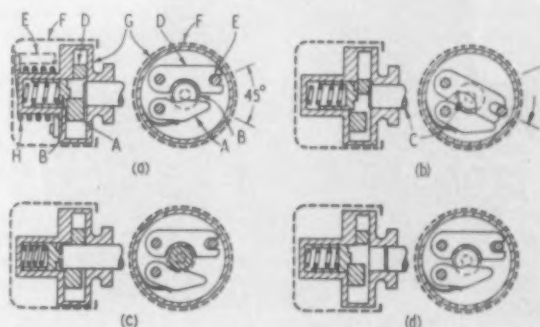
The Simms unit is fitted to the fuel pump body and operates on the end of the control rod, or rack. Prior to starting the engine, the driver operates it simply by rotating the knurled outer casing F through an angle of 45 deg, and allowing it to return again immediately under the action of a torsion type coil spring inside the unit. From the description that follows, it can be seen that if the outer cover F should be fixed in any way, to prevent it from returning to its original position, excess fuel is not obtained. Therefore, there is no simple way in which the driver can meddle with the device so that excess fuel can be delivered to the engine under normal running conditions.

The method of operation of the mechanism can be seen from the accompanying illustration. At *a*, the unit is shown in the normal position, and the 45 deg arc through which it can be rotated is indicated. When the outer cover is rotated through 45 deg, as at *b*, the peg that projects inwards from the cover moves the baulk lever D into a position such that it prevents movement of the control rod C towards the excess fuel position. At the same time, the baulk lever D pushes the stop lever A clear of the path along which the control rod C moves when it comes into the excess fuel position. This allows the plunger B to move, under the influence of its com-

pression spring, until it is stopped by the baulk lever D. In this position, the plunger prevents the stop lever A from moving subsequently into the path of the control rod C.

When, under the influence of the torsion type coil spring, the outer cover F returns to its original position, its peg returns the baulk lever D, but the stop lever A, as has already been mentioned, cannot return. In this condition, the assembly is set as shown at *c*, so the control rod is free to move into the excess fuel position. When the engine starts, the control rod C automatically moves back into the normal running position and since the diameter of the plunger is slightly less than that of the control rod, the stop lever A holds back the plunger B. Thus, the stop and baulk levers are freed, and return to their original position, which is as shown at *d*.

The Simms excess fuel device is mounted on the body of the fuel pump and it operates on the end of the control rod, or rack, of the unit



SURFACE GRINDERS

Interesting Single-Spindle Horizontal Machines Developed by F. E. Rowland and Co. Ltd.

A NUMBER of special purpose horizontal, single-spindle surface grinding machines have recently been developed by F. E. Rowland and Co. Ltd., Climax Works, Reddish, nr. Stockport. They incorporate basic units from the well known Rowland range of duplex surface grinders together with specially designed work fixtures. These machines have been engineered for grinding, on a continuous basis and to close limits of accuracy, single faces on components required in large quantities.

The machine shown in Fig. 1 has been developed for grinding the end faces of small pistons used in the brake mechanisms of motor cars. It is arranged for fully automatic operation, being equipped with automatic measuring devices and automatic wheel truing. The machine carries a 20 in. diameter abrasive disc of the inserted nut type mounted on a substantial spindle that runs in precision pre-loaded ball and roller bearings. Drive to the grinding wheel spindle is by multiple vee belts from a 7½ h.p., totally enclosed, fan-cooled motor mounted on the top face of the grinding wheelhead. The grinding wheelhead is universally adjustable to enable the required angularity to be maintained between the abrasive disc face and the work fixture. It is mounted on hand scraped slideways secured to the top face of the machine bed, which is of substantial fabricated steel construction, a form that has been preferred to cast iron because of the various designs required for different machines.

Fig. 2 shows the work fixture. It has a number of stations equally spaced in the periphery of the carrier, which is driven at infinitely variable speeds between 1 and 3 r.p.m. approximately. Drive to the work carrier spindle is taken from a ½ h.p. motor via a variable speed belt drive and a double reduction worm box unit.

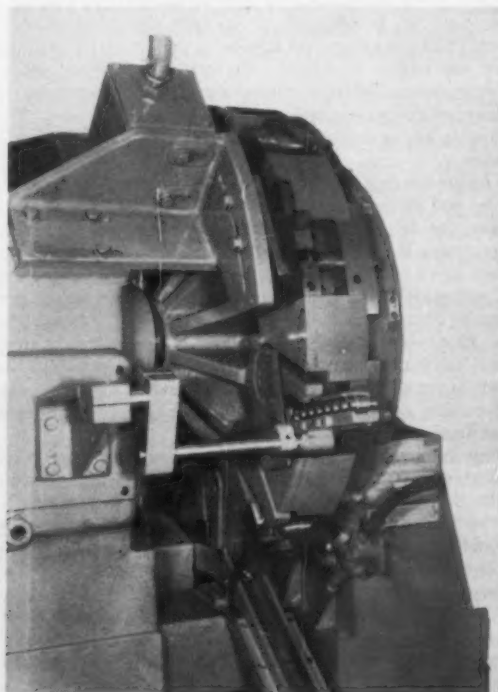
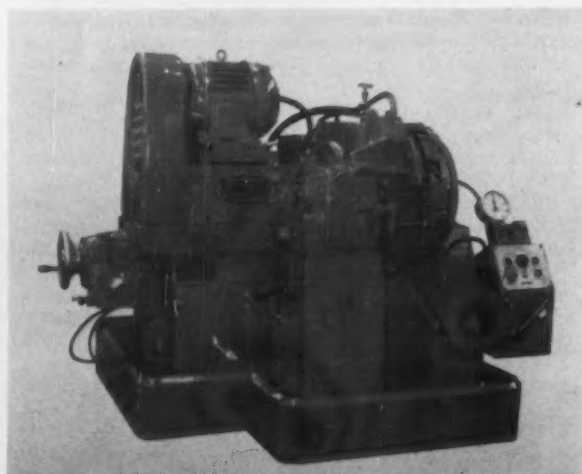
Each work carrier station consists of a vee block into which the workpiece is loaded from a gravity-feed chute. The face formed at the end of the vee block provides the end location for the workpieces, which are held against it by a spring loaded guide immediately prior to being clamped. Clamping is effected by means of a clamp arm, provided with a hardened tip, actuated from a circular cam track located inside the work carrier body. The cam track is so designed that the workpiece can drop into position in the work carrier station from the loading chute, is then clamped before entering the grinding area, and after grinding is released to fall by gravity in to the delivery chute.

The clamp arms are arranged to clamp the workpiece by spring pressure and to release the clamp by means of the cam track. This arrangement has been adopted to safeguard the clamping mechanism if a workpiece is incorrectly loaded. Should incorrect loading occur, a safety switch incorporated in the design causes rotation of the work carrier to cease before the incorrectly loaded work reaches the grinding area. The design of the work carrier is such that all parts subject to wear are totally enclosed and protected against the entry of swarf and coolant. The grinding wheelhead is held against a dead stop by means of an externally mounted hydraulic cylinder. A conveniently placed control valve is provided for rapid wheelhead withdrawal when grinding wheel replacement is necessary.

A wheel wear compensation unit is incorporated in the design. It is attached to the end of the grinding wheelhead. Its purpose is to enable pre-set and variable amounts of in-feed to be applied to the grinding wheelhead to compensate for grinding wheel wear either by the operation of a push-button on the control panel or by means of signals received

Fig. 1 (Below). Rowland special purpose surface grinding machine. It incorporates measuring equipment that causes application of in-feed to compensate for wheel wear

Fig. 2 (Right). The work fixture of the machine shown in Fig. 1



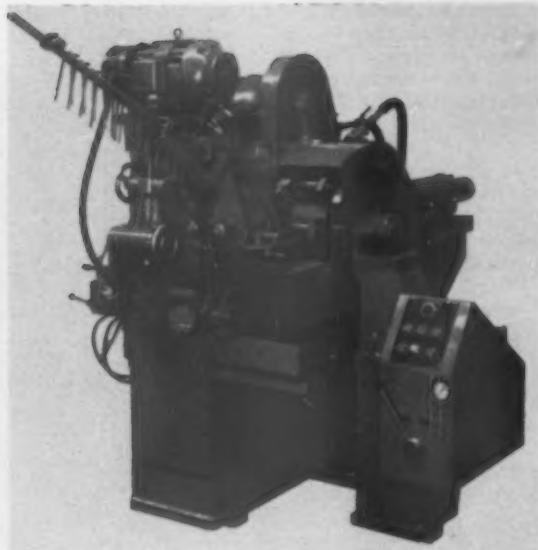


Fig. 3 (Above). Rcwland special purpose surface grinder for valve stems

Fig. 4. The automatic loading unit, the work carrier and the abrasive cutting-off head of the machine shown in Fig. 3

from the automatic measuring equipment. The increments of in-feed are infinitely variable from 0.0001 in. to 0.0024 in. They are effected by means of a solenoid-operated hydraulic cylinder that operates the lead screw via a roller clutch and worm gear assembly. Coarse and fine feed handwheels are provided for initial setting purposes.

The measuring equipment is pneumatically operated. It comprises a tungsten carbide measuring head, mounted on an adjustable slide for setting purposes, and an indicating dial that contains sensitive electrical contacts and is calibrated in 0.0005 in divisions. This measuring head is so arranged that each component passes across the face of the head immediately after leaving the grinding wheel. Contact between the component and the measuring head causes deviation in size from a known datum to be registered visually on the indicating dial. The electrical contacts in the dial are so set that when a workpiece is approaching the "plus" length tolerance, the resulting electrical impulse is used to operate the wheel wear compensation device to impart in-feed to the grinding wheelhead so that the work is ground to a size approaching the "minus" length tolerance.

An automatic wheel truing device is provided. It is mounted horizontally on the rear of the substantial grinding wheel guard. The truing device consists of a hydraulically operated ram with a micrometer type, single point diamond tool mounted in the end. The sliding surfaces of the ram are enclosed in all positions completely to exclude all abrasive particles. Wheel truing is carried out on a time interval basis. A timing device, located in the electrical control cabinet, can be pre-set to cause wheel truing to be effected automatically at any interval up to four hours. An over-riding push-button control is included in the electrical equipment, and a red warning light indicates when the grinding wheel has reached the end of its useful life.

The wheel guard is split along its horizontal centre line, and the top half is removable for grinding wheel replacement. Grinding is carried out wet. As the machine stands in the coolant reservoir, a considerable saving in floor space is effected. Suitable means of coolant separation are provided. Hydraulic power is provided from an externally located pump

unit. All control valves are of Stein and Atkinson manufacture.

Two machines of similar type are used by Vauxhall Motors Ltd., for semi-finishing the stem ends of engine valves. One of these machines is shown in Fig. 3. In addition to the main grinding wheel it incorporates an abrasive wheel cutting-off head. The valves are presented to the machine in the "as forged" condition and have a surplus length varying from $\frac{1}{8}$ in to $\frac{3}{8}$ in at the stem end. At the first operation on this machine the surplus metal is cut-off to bring the valve to the rough grinding length.

An automatic loading device, designed and manufactured by Vauxhall Motors Ltd., delivers the valves to the work fixture carrier. Fig. 4 shows the loading device, the work fixture carrier and the abrasive cutting-off head. After being loaded on to the work carrier the valve is located endwise by means of a spring-loaded guide, is clamped and then passes across the cutting-off wheel for the removal of surplus metal.

The 12 in diameter abrasive cutting-off wheel runs at a surface speed of 12,500 ft/min. The spindle carrying this wheel is mounted on precision pre-loaded ball bearings, and is driven by multiple vee belts from a 5 h.p. totally enclosed, fan-cooled motor. Although the cutting-off wheelhead is arranged to pivot, it is always used in the lowest position so that the component to be cut passes across the longest possible arc. Because of this arrangement, the wheelhead does not require any adjustment during the life of the abrasive wheel.

Manually operated, screw-feed adjustment is provided to enable the wheelhead to be pivoted clear of the work carrier when wheel replacement is necessary. To allow the correct relationship to be maintained between the cutting-off datum and the amount left for finish grinding, the cutting-off wheelhead is mounted on a lateral slide with screw feed adjustment.

The machine is arranged for wet operation with the coolant reservoir situated at the rear. After grinding, the valves are discharged by gravity into a work tray. Special arrangements have been made to handle the comparatively large amounts of swarf. Cut-off ends are deposited in a special basket for periodic removal, and a copious supply of coolant ensures that all swarf is washed out at the rear of the machine.



This Foden model FR.6/45 dumper is designed to carry a payload of 56,000 lb.

HEAVY-DUTY DUMPER

A Foden Vehicle to Carry a Payload of 56,000 lb.

THE dumper shown in the accompanying illustration has been developed by Fodens Ltd., Sandbach, Cheshire, to carry a payload of 56,000 lb (28 short tons). A Rolls-Royce standard turbo-blown engine is used as the power unit. This is a six-cylinder, four-stroke unit, with 5½ in bore and 6 in stroke and a total displacement of 12·17 litres. It develops 300 b.h.p. at 2,100 r.p.m. The maximum torque is 840 lb-ft and the corresponding fuel consumption is 0·355 lb/b.h.p./hr.

A monoblock cylinder construction with a two-piece cylinder head is used. All the major engine components are pressure lubricated, and the oil is cooled by the radiator water circuit. Detachable wet sleeve cylinders are fitted. Each of the light alloy pistons is fitted with three compression rings and one grooved oil scraper ring. The crankshaft is supported on seven main bearings and is fitted with a viscous damper. The fuel pump, camshaft and oil pumps are gear driven, whilst the water pump, fan and dynamo are belt driven from the front of the engine.

This Rolls-Royce power unit has a wet sump and is arranged to operate on gradients up to 1 in 4. A Simms fuel injection pump is fitted. It has a mechanical governor and is fitted with an excess fuel device for cold starting. Fuel is sprayed through multi-hole injectors direct into the toroidal combustion chamber formed in the piston crown. Particular attention has been paid to engine suspension. The engine and torque converter are mounted on a three point rubber suspension. At the front end there are two links insulated by rubber bushes, while at the rear end two Silentbloc mountings on each side take care of load and torque reactions.

Transmission

Drive from the engine to the torque converter is taken through a 17 in O.D., 10 in bore Rochford over-centre clutch. The function of the Rochford clutch is to give a free engine-running position when the engine is idling. It is also used to

engage the gearbox. The clutch pedal is so arranged that alternate depressions engage and disengage the clutch.

The hydro-dynamic torque converter has a centrifugal impeller, driven by the engine, and a centrifugal turbine, driven by the fluid and connected to the output shaft. As this three-stage torque converter is an automatic and infinitely variable torque-ratio transmission, it will, within its designed operational range, adjust the torque delivered to the final drive to correspond with the resistance. In practice the torque output to input ratio can vary from 1:1 up to 5·3:1 progressively as the speed of the output shaft decreases from maximum to zero. A C.O. type torque converter is used. It has a robust freewheel that locks the turbine to the impeller during over-run. This enables engine braking to be used to augment the hydraulic braking effect of the converter. Diesel oil taken from the main fuel tank operates the converter. The oil is cooled by a heat exchanger inserted in the engine fresh water circuit.

A very robust gearbox with three forward speeds and one reverse is fitted. It is designed specifically to operate in conjunction with the torque converter and has 85 tons tensile nickel chrome steel, hardened and ground, gears throughout. The casing is very rigid and is made of spheroidal graphite cast iron. Anti-friction ball or roller journals are used for all bearings. The gearbox unit is mounted independently in the frame, and drive to it from the converter is by shaft and two Layrub universal joints.

The gear ratios and the approximate maximum speeds obtainable with the vehicle laden are:—

Gear	Gear ratio	Approximate max. speed laden
3rd	0·75:1	24·0 m.p.h.
2nd	1:1	19·5 m.p.h.
1st	2:1	10·0 m.p.h.
Reverse	1·725:1	12·0 m.p.h.

For normal operation with this type of vehicle, either the low ratio, 2:1 of the medium ratio, 1:1, will be selected and used throughout, dependent upon site conditions and gradients. Once the appropriate gear has been selected and the clutch engaged, all control of speed is done by means of the engine accelerator; further gear changes are unnecessary. The over-drive ratio is for light running at relatively high speeds. Splash lubrication is employed in the gearbox. A Hardy Spicer 1900 series propeller shaft is used for the transmission from the gearbox to the rear axle.

Rear axle

The rear axle has been specially designed for dumper duty. It incorporates a spiral bevel reduction unit and differential in the centre and a hub reduction in the wheel hubs. Pre-loaded taper roller bearings and a roller journal bearing carry the bevel pinion in a steel housing, whilst the differential carrier is mounted on taper roller bearings. The differential has four large bevel pinions carried on bronze bushes. Deflector plates at strategic points direct oil on to the spiral bevel teeth and the bearings. A massive steel casting, to which is bolted a flanged tube at each side to carry the hubs and brakes, houses the whole unit. A spiral bevel reduction of 3.71:1 is employed, with a hub reduction of 4.94:1 making the overall rear axle ratio 18.4:1.

A planetary system is used for the hub reduction. The pinions are carried on roller bearings and the whole unit runs in oil. Two roller journal bearings carry the hubs. Of these, the outer is 14½ in O.D. and the inner 15½ in O.D. Adequate face seals are provided to seal off the hub reduction units and the inner wheel bearings from the brake drums.

As the axle casing is bolted direct to the main frame, Bellville washers are fitted to give a small amount of freedom to obviate twisting the casing. Each axle shaft is 2½ in diameter with a 2½ in diameter, 16 spline end. The wheels fit direct on to the outside of the hub and are retained by screws and 14 cleats on ½ in studs. They locate on a taper. The rear brakes are 19½ in diameter × 8 in wide with ½ in thick linings. Each brake shoe is carried on a pin which is lubricated. Brake operation is effected through an "S" type cam. Adjustment is by means of a worm type of adjuster located on each cam operating lever. The camshaft is grease lubricated. The rear axle track is 7 ft 4 in and the width over the tyres 10 ft 11½ in.

Front axle

Kirkstall Forge Engineering Ltd., Leeds, made the front axle which has an I-section steel forged beam 7½ in deep. The swivel centres are 7 ft 3½ in. Taper roller bearings carry the wheels, and the stub axle is 4½ in diameter at the inner wheel bearing. The king pin has a separate taper roller thrust bearing and has a bronze bush 2½ in diameter × 3 in long at the top and one 3 in diameter × 3½ in long at the bottom. Conventional steering levers and tie rod are used. The wheels are located on a taper and are retained by 12 ½ in studs. "S" type cam operated front brakes are fitted. They are 19½ in diameter × 7 in wide, with ½ in thick linings. Adjustment is carried out at the end of the camshaft by means of a lever and jaw mechanism.

In the front axle suspension, which is designed to give three point suspension, the two semi-elliptic springs are mounted transversely across the frame on two trunnion brackets and large diameter floating pins. The springs have an eye at only one end. This eye locates the axle sideways; the other end slides on a slipper block. Fore and aft location of the axle is by two channel members which come forwards and upwards. They are anchored on a ball pin to take all the forward impact load and brake torque reaction.

Conventional air-pressure type footbrakes are fitted. They use Clayton-Dewandre units. The compressor, which is of the Tu-Flo "500" type, has a capacity of 12 ft³ of free air per

minute at 1,250 r.p.m. It is engine driven, lubricated and water cooled. The front wheel cylinders are of the piston type and have 6 in bore and 2½ in stroke, whilst the rear have 6 in bore and 5½ in stroke. The air reservoir of 5ft³ capacity operates at 80/105 lb/in² pressure. A pressure gauge is fitted in the cabin and a warning light indicates when the pressure falls below 60 lb/in².

A tyre inflator, with a gauge, is fitted on the side of the frame. It takes air from the reservoir. A hand control valve is also connected to hold the footbrakes by manual control. A 20 in diameter, disc pattern hand brake is fitted. It is mounted immediately behind the gearbox and has caliper action for the two linings, each independently adjustable.

An 18 in × 6 in rolled joist section is used for the frame. It is tapered down to 12 in at the front end. The front cross-member is welded in position, and supports the engine radiator and the front suspension torque rod bracket. Both the tipping ram support member and the rear cross-member are also welded into position, while the cab support members and the gearbox members are bolted in position and add rigidity. The front bumper bar is 12 in deep and extends to the full width. It incorporates a pulling jaw.

Steering gear of Foden design and manufacture is fitted. It employs the re-circulatory ball gear system, power assisted by a power cylinder mounted directly to the steering casing. The linkage with the power cylinder is external, and is so arranged that all shock loads are isolated from the steering segment. The gear oil pump is engine driven and the system operates up to a maximum pressure of 1,000 lb/in², according to the demands made upon it.

Clean engine oil is used in the hydraulic system. Safety valves ensure that there is no danger of locking the gear if the engine stalls or the pump fails. This power assistance gives adequate assistance under all conditions. It is, however, so arranged that it will not turn the road wheels when stationary, since this can lead to excessive tyre wear and damage.

Body construction

All welded construction is used for the body, which has a capacity of 18 yd³. Pressed steel channel, 7 in × 5 in, is used for the main framework. Sandwich construction is used for the floor, which has a ½ in steel bottom plate, 1½ in oak planking and a ½ in top plate. The side plates are ½ in thick. All the plates used in the body construction are of a special material developed to be abrasive resistant and three times more resistant to indentation than mild steel. As an alternative, the floor can be made from a single ½ in thick plate, reinforced by 3 in × 3 in angles on the edge. This construction is more suited to hard rock, while the smooth floor of the standard body is intended for more general conditions. A protective canopy extends over the driving cab.

The fully enclosed all-steel cab is offset slightly to suit the left-hand controls. There is access to the cab from both sides, and care has been taken to see that the driver has good visibility. The driver's seat is mounted on a spring base and is adjustable. A cab heater and demister are fitted. All the controls are carefully grouped for the driver's convenience.

A Hamworthy pump is used for the hydraulic tipping gear. It is robustly constructed and has balanced bi-metal wear plates on the side faces. The hardened alloy gears are all carried on needle roller bearings, and a thrust location bearing is provided on the input gear. A double-acting tipping ram is employed. It operates on to a pivot beam, which has guided rollers that lift the body. The tipping oil tank is located beneath the cab floor, while the control valve is mounted behind the cab. This control valve has a "lift", "hold", "power down" and "float down" positions. It also incorporates a safety valve to limit the pressure in the hydraulic system. The time taken to tip to 65 deg is 8 seconds. Power return takes 5 seconds.

WELDING AUSTIN-HEALEY CAR BODIES

Production Methods at the West Bromwich Works of Jensen Motors Ltd.

RESISTANCE welding plays a most important part in the body building industry and a prominent feature of any mass-production plant is the lines of more or less elaborate automatic welding machines which unite numerous sheet steel panels and sub-assemblies into the typical unit-construction body shell. Other modern welding methods, however, are likely to be more applicable where the scale of operations does not justify the installation of expensive and complex tooling.

Small-scale production

It is not only the cost of the plant and equipment that prevents large resistance welding machines from being used in relatively small-scale production. Matched press tools for body panels are so costly that enormous production runs are required to amortise them. Hand panel-beating, therefore, is employed for small quantities, while rubber press tools, requiring only a shaped male die instead of an intimately matched pair of tools, can cope economically with intermediate quantities. Light alloys, on account of their ductility and ease of working, are widely used in conjunction with these forming methods. Furthermore, with the class of car commonly built in such limited numbers, weight saving is often of some importance.

Resistance welding is unsuitable for use on aluminium alloys, and an attractive alternative is inert gas-shielded arc welding. This method is being increasingly employed in plants concerned with the production of specialist and high-performance cars, and also for goods and passenger vehicle

bodywork. Apart from the main advantage of the process, the prevention of oxidation of the heated metal, it provides clean, smooth and strong welds and has an easily controlled underbead. These are useful features where finish is important, as it is in these sections of the motor industry.

A good example of the class of car to which the above considerations apply is the Austin-Healey sports model. While this car is a popular representative of its type, it is designed for a relatively limited public and cannot be produced in anything approaching the numbers usual for the typical family saloon. The body shell is a composite steel and light alloy structure, manufactured at West Bromwich by Jensen Motors Ltd. This firm has a long connection with specialist car production, and has acquired wide experience in the production methods economically applicable to limited outputs.

To provide the stiffness essential for stability at high speeds, the chassis frame is a fabricated steel structure of great depth, additional strength being provided by the body side panels which are also of steel. The remainder of the shell, comprising front and rear ends and top decking, is generally of 16 S.W.G. aluminium-manganese alloy to B.S. 1470 N.S.3. This combination of materials results in a very favourable overall strength : weight ratio.

Extensive use of aluminium

In the complete body, the light alloy structure comprises two large one-piece sections, forming respectively the whole of the upper surfaces before and behind the cockpit. To



General view of the welding shop. The three jigs, from left to right, contain tail, nose and bonnet sub-assemblies. All are fabricated in aluminium alloy by Argonarc welding

simplify assembly and tooling, each main panel is built up by welding together a number of smaller sections. The general view of the welding shop shows the breakdown of sub-assemblies quite clearly. In the foreground the nose-shell section, comprising four small and simple pressings, is mounted on a jig. At the left, a complete tail section, built up from seven separate parts, is ready to be removed from its jig. At the right, the nose-shell section is about to be welded to the bonnet-top structure, which is itself made up from three sections.

This method of assembly reduces both the size and the complexity of the formed parts, most of which receive their basic shaping in a rubber-platen press. Re-entrants, flanges and small cut-outs are formed by hand panel-beating in special jigs. Extremely accurate jiggling is called for to obtain the required accuracy, and a high standard of welding is demanded to ensure that the panel joints are invisible. That these aims are attained is evidenced by the excellent finish of the completed body.

Probably the most important factor affecting appearance is the choice of Argonarc welding for all the panel joints. The advantages of this method from the point of view of protection of the light alloy material from oxidation is well established. What is equally important in this application is the very small amount of distortion which results from the cooling effect of the argon gas shroud, and the speed with which welding can be effected. Much thought has been given to the design of the jigs to clamp the panels firmly in alignment, to maintain the correct spacing between joint faces, and to control the welding underbead.

Welding jigs

The jig for the nose assembly, with the individual panels in place, is illustrated. The clamps, which are specially shaped to form welding guides, can be seen in the open position. When they are closed, they automatically position the panels to leave a maximum weld gap of $\frac{1}{16}$ in.

One of these clamps in the open position is shown in detail, this time as part of the jig for the bonnet top assembly. The upper half of the clamp is slotted along the centre line, giving access to the upper surface of the panels for a width of about $\frac{1}{4}$ in on each side of the joint line. The sides of the slot are



The four small sections which make up the nose sub-assembly, before the welding jig is closed

chamfered to provide easy access for the welding torch.

Penetration is controlled by a semi-circular groove formed in the lower, fixed half of each clamp. This ensures a neat underbead, about $\frac{3}{16}$ in wide and $\frac{1}{8}$ in deep. Since all the proud metal on the outer, visible surface of the panel is ground away to provide a smooth finish, the underbead forms a reinforcement to the joint. The clean appearance of the underside is well shown in the view of the reverse side of a joint in the bonnet top panel. No post-welding treatment of any kind is required. This illustration also gives some idea of the complete lack of distortion in the light-gauge material.

Reference has been made to the importance of correct alignment of the sub-assemblies. One of the ways in which this is attained is shown in application to a completed nose section, subsequent to welding and smoothing down the top beads. Before it is mated to the bonnet top panels, the

One of the special slotted clamps which hold the bonnet sections in position and form welding guides



A small groove in the lower half of the clamp controls the welding underbead, giving it a clean profile



A typical underbead, showing the neat appearance of the seam and absence of oxidation or flux residue





The rear edges of the nose sub-assembly, which mate with the bonnet top, are cut to correct angle in this special guillotine

upper rear edges must be carefully shaped to the correct angle. This operation is carried out in a simple trimming jig. The nose section is clamped in a fixture, resembling the welding jig in which it was assembled, and two large shear blades are brought down on the rear edges to cut a clean, accurately positioned face ready for welding. In the same fixture, the two levers at the front are manually operated to punch a hole

in the flange at each side of the panel for its eventual attachment to the chassis structure.

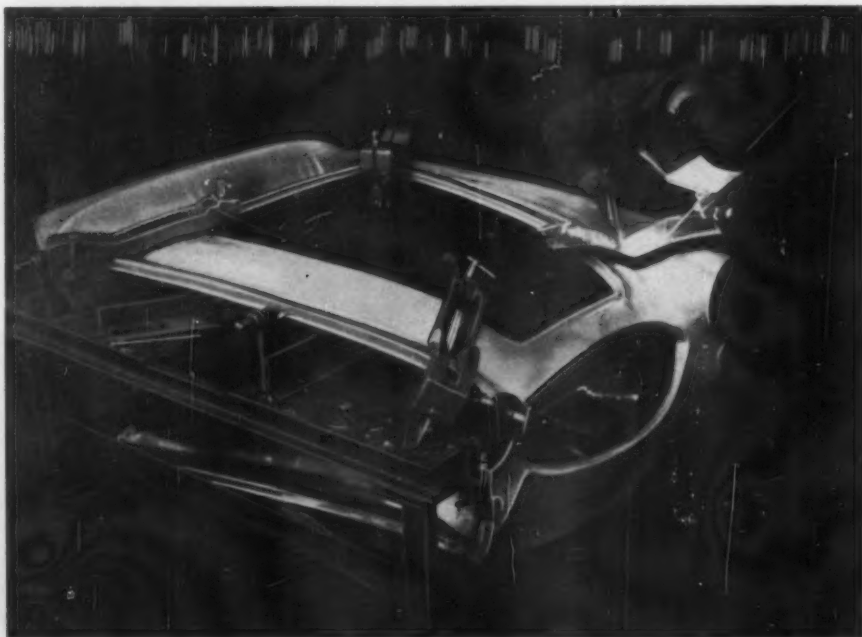
The final stage in the fabrication of the large front panel consists of welding the nose section to the bonnet top section in a large jig built on similar principles to the others. Welds are then ground down and the seams are smoothed by hand tools, as shown in the illustration of an operator finishing one of the longer welds between the two parts.

Electrical equipment

There are several points of interest in the welding technique and in the equipment used, which is of the latest type manufactured by the British Oxygen Co. Ltd. As is usual in the Argonarc welding of aluminium alloys, alternating current is employed. The reason is that with electrode-negative direct current, which gives efficient heat transfer to the work, the well-known scavenging effect on the refractory oxide film is absent. Electrode-positive direct current, on the other hand, while providing the necessary oxide removal function, concentrates most of the arc heat at the tip of the tungsten electrode. With the high thermal conductivity of aluminium, this results in shallow penetration and low speed, as well as introducing the danger of contamination from the molten electrode tip.

Current is supplied to each pair of torches by a Quasi-Arc ACP 2/300 transformer welding set, which can supply 300 A simultaneously to each torch. High-frequency units are inserted in each circuit to provide instantaneous re-ignition of the arc at the zero point in each half-cycle, and to ensure automatic initial ignition without contact between electrode and work. This device consists essentially of a spark-gap oscillator which superimposes a train of high-frequency oscillatory voltages on the main 50 c/s supply, phased to occur at the zero points. Each train has a duration of several milliseconds, sufficient to re-establish the arc without the need for an excessively high arc voltage.

Inherent rectification of the welding supply in the arc, which gives rise to an undesirable D.C. component, is countered by including in the circuit a D.C. suppressor unit, consisting of a bank of series capacitors which effectively



Joining the front and bonnet top sections, using a Mk. III water-cooled Argonarc torch. Welding current is 127 A, open-circuit voltage 100 V

The only finishing operation required is to grind and polish the welds, which are then ready for painting. The joint at the left has been cleaned-up and is invisible



block the direct current. By ensuring that the electrode-positive half-cycle will be as long as the electrode-negative, efficient scavenging of the refractory film is ensured.

The illustration of the welding operation uniting the nose and bonnet-top sections shows the typically oblique angle at which the $\frac{1}{8}$ in Alda pure aluminium filler rod is held at the leading edge of the advancing weld pool. The torches are of the Mk III water-cooled type, water and argon flows being controlled through an economizer unit on a bench. When the torch is not in use, it is hung on a small hook which automatically closes both the argon and the water valves.

The open-circuit voltage is 100 V, and each torch takes 127 A, under which conditions the average welding speed is about 10 in/min. There is a total of about 13 ft of welding in each complete set of panels. The average weekly output of complete units is about 125, which represents a very creditable figure when the time required for handling is

taken into account. Argon is fed at 12 to 16 ft³ per hour, the consumption being very modest at 300 ft³ per week, or just over 2 ft³ per body.

Finishing details

One interesting point in connection with the assembly is that, on some of the panels, flanges round openings must be hammered flat over a short distance to allow the part to lie evenly in the jig. It is not possible to weld right to the end of the joint because the clamp is in the way. In such cases, the joint is completed after removal from the jig, using an ordinary oxy-acetylene torch, aluminium filler rod and Alotectic flux. The extra heat from the use of the flame has been found to have a useful annealing effect which eases the subsequent operation of restoring the flange to its original contour by panel-beating.

When the two main panels are completely assembled, they



The completed body, fitted to a left-hand drive Austin-Healey chassis for export

are prepared for finishing by a skilled panel beater. Irregularities in the panel surfaces caused by handling, or due to marks in the original sheet, are planished out and the weld beads on the outer surfaces are ground flush, filed, scraped and polished, as illustrated. So good is the finish at this stage that no sign of the weld is visible, and no solder or other filling is required before painting. The neat underbeads, as already mentioned, are left untouched to provide a degree of reinforcement. They have a useful incidental function in that, in the event of subsequent accidental damage too severe to be beaten out, they delineate the exact position for cutting out and welding in a replacement panel.

Range of torches

Although the equipment used by Jensen Motors Ltd. for this high-class work is simple and compact enough to encourage its use in the smaller workshop and even for repair work where aluminium or its alloys are concerned, its capacity for heavy work is considerable. The water-cooled Mk III torch can weld continuously at 300 A, or higher for intermittent duty. For sustained operation at high currents,

a water-cooled shield is available to replace the normal ceramic argon shield. This modification makes possible the continuous welding of aluminium up to $\frac{1}{2}$ in thick. With the ceramic shield, the normal limit in aluminium is $\frac{3}{8}$ in.

For even heavier work, the Mk V torch can handle up to 600 A, while at the opposite end of the scale there is a simple air-cooled Mk IIa torch for welding at up to 100 A. The usefulness of the Argonarc technique has been greatly extended by the introduction, chiefly in response to the demands of the aircraft industry, of two miniature models, known respectively as the swivel-headed torch and the pencil torch. Of extremely compact design, the pencil torch is only about 5 in long, and is held in the hand in the same manner as a pencil. The cable is fed through the bore of the transparent argon tube, which enhances the ease of handling. This model, and the swivel-headed version which incorporates a head that can be adjusted through an angle of 48 deg, can be applied and operated in the most awkward locations. Despite their small size, they can work intermittently at 75 A. They can safely be used on stainless steel and other metals down to 0.02 in thick, producing neat and sound welds.

New Plant and Tools

Recent Developments in Production Equipment

IN recent years there has been a rapid extension in the use of mechanical vibrations, at frequencies above the audible range, for such practical operations as cleaning, homogenization, pigment dispersion, and sterilization. What is claimed to be the highest possible standard of cleaning available to industry, involving the application of ultrasonic vibrations under vacuum conditions, is now offered in plant

supplied by Electro-Chemical Engineering Co., Ltd., Woking, Surrey. The process was introduced by Technochemie, of Switzerland, and at first was almost exclusively used by the Swiss watch industry for very small and intricate mechanisms. It has now been developed to large installations that can handle a considerable mass of components at a high through-put. Nearly one hundred production installations are already being operated in Europe and America.

The frequencies employed are from 400 kc/s down to 40 kc/s and the transducers are of piezo-electric type, made of barium titanate. Frequencies lower than these can, in some instances, cause damage to fragile parts or, if low enough, affect the work by erosion. The advantages of the vacuum technique are substantial. Air is extracted from the solvent and air pockets are removed from any intricate component, thereby engendering the good solvent-to-surface contact which is essential for satisfactory cleaning. Impacted compound in small blind holes is also easily and readily removed.

Cleaning sequences are varied to meet specific requirements but usually are arranged on the following lines. First there is a pre-cleaning operation with perchlorethylene or trichlorethylene, with continuous filtration. Next comes the ultrasonic stage, with or without vacuum, but with continuous filtration using the same solvent. There follows a continuously filtered rinse, also using the same solvent, a vapour degreasing process and, finally, a drying stage which may include the use of vibration, infra-red heat or a stream of hot, filtered air. All these processes may be incorporated in manually controlled or fully automatic machines.

The use of this ultrasonic metal cleaning technique opens up new possibilities of extreme cleanliness in those industries in which even minute amounts of dirt adhering to the metal surfaces can be of grave consequence. The illustration shows a fully automatic plant for cleaning component parts of fuel injection equipment.

Fully automatic ultrasonic cleaning plant
Electro-Chemical Engineering Co. Ltd.



Autal thread-tapping heads

For a period of eighteen months the German-manufactured Autal tapping heads have been in service in a number of British engineering plants for testing and proving. They are now being made generally available from stocks held by Optical and Mechanical Devices, Westhead Chambers, George Street, Kingston Road, Staines, Middlesex.

Autal heads are produced in two types. Model A has a built-in reversing mechanism for use on single-rotation spindles, while Model B is uni-directional and intended for machines equipped with a reversing switch. Both types have a friction clutch mechanism which automatically arrests the forward motion of the tap if the preset torque is exceeded. Operating torque is set by turning a ring on the top of the head, the ring being graduated into ten divisions for easy reference.

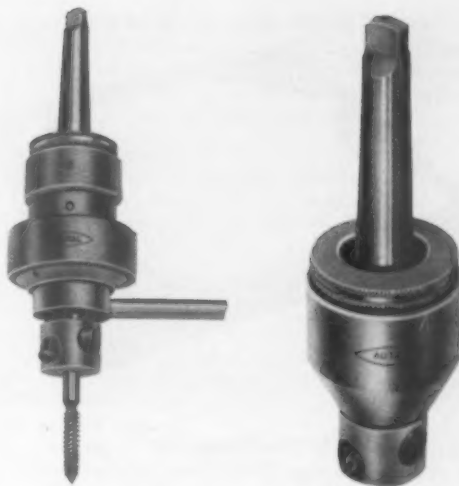
The tap holder consists of two metal cylinders slidable in bores at right angles and fitted with Allen screws for securing the tap first at the shank, for centralizing, and secondly at the square, for driving. No special collets are required. On the reversing type head a torque bar of appropriate length to engage a positive stop on the machine column or table is fitted. For tapping to depth the spindle stop is set and when this is reached the clutch disengages the forward gear in the head. When tapping blind holes the drive is disengaged when the preset torque is exceeded. On reversing the spindle feed lever, the planetary gear in the head is engaged and the tap is withdrawn at twice the forward rotational speed. This reverse drive is registered from the torque bar.

Five models of the A-type reversing head and four sizes of the B-type non-reversing head each cover a range of tap sizes from $\frac{1}{16}$ in diameter to $1\frac{1}{2}$ in diameter. Button die holders are available for thread diameters from $\frac{3}{16}$ in to $1\frac{1}{2}$ in.

Automatically controlled drilling

Now in full production, the recently introduced Maxam Woodpecker drill unit has been designed to give automatic control of drilling operations, at an increased rate of working, and with improved accuracy. This air-operated unit, of $\frac{1}{2}$ in diameter drill capacity, incorporates hydraulic feed control, chip clearance by means of its automatic peck action, and a rapid, sensing approach.

The forward feed rate is infinitely variable by hydraulic control and there is a rapid return stroke. The unit will drill to a preset depth against a positive stop and will then return to the starting point. The drill advances rapidly until the work is contacted and then automatically commences drilling at the preset controlled rate of feed. After the rapid sensing approach the drill penetrates to a preset depth and then automatically retracts, thereby clearing chips from the hole and the drill flutes. Immediately and automatically it again advances rapidly until the drill contacts the bottom of the hole and then drilling continues. On the returning cycle the air supply to the drill is cut off, thus keeping air consumption to a minimum, and on its forward stroke the drill recommences to rotate. This peck action continues throughout the



Autal tapping heads, reversing and non-reversing types
Optical and Mechanical Devices

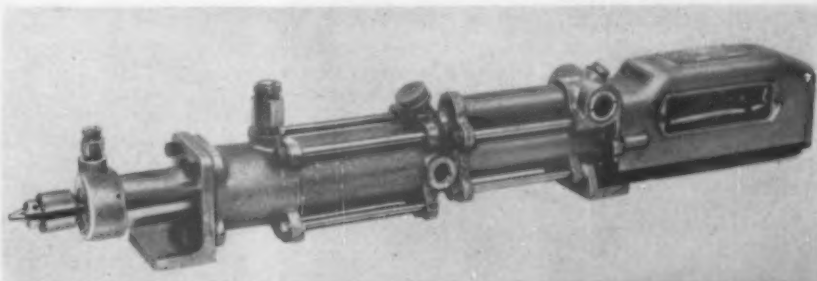
whole operation until, on reaching the required depth, the drill finally retracts to its starting position and stops.

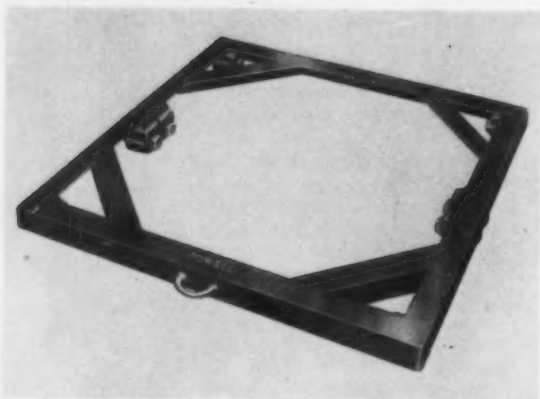
Depth of peck is infinitely variable. If required the drill can be arranged to rotate slowly on the return stroke and in its reset position. It can also function without the peck action if so desired. The unit is particularly suited for drilling through a tube, a channel section, or a spaced assembly. The drill advances rapidly to contact the workpiece and drills through one section at the controlled rate of feed. It then automatically advances rapidly until contact is made with the second wall of the work, when once again it will drill at the controlled feed rate.

The standard chuck speed is 2,400 rev/min, but alternative gear boxes are available for spindle speeds of 540, 970, 4,000 and 6,000 rev/min. Two standard units are produced, type MX.588 having a 2 in stroke, and type MX.589 having a 4 in stroke. The drill is controlled by a Maxam 4-way, double-solenoid operated valve, which is normally recommended to work from a supply transformed to 12 volts A.C. This valve, however, can be supplied with coils suitable for most standard A.C. or D.C. voltages. In addition a suitable relay is necessary and can be supplied with the unit. The unit can be mounted in any position between the horizontal and vertical.

Woodpecker drill units are manufactured by the Maxam Division, Climax Rock Drill & Engineering Works, Ltd., Carn Brea, Cornwall, one of the companies of the Holman Organization. Further developments are in hand and, later this year, larger units that will have particular relevance to the wood-working industry will be available.

Maxam "Woodpecker" drill
unit
Climax Rock Drill and Engineering
Works, Ltd.





Pallet-handling bogie truck
Powell and Co.

Pallet bogie truck

This new low-loading bogie truck is particularly intended for handling either empty or loaded pallets up to a maximum load of 1,500 lb. It can usefully serve to supplement the work of a fork-lift truck or as an alternative means for manhandling pallets where or when a lift truck is not available. Empty pallets can be moved into lifts, or into restricted storage areas not accessible to a lift truck, in order to keep space clear for the handling of loaded pallets. Towing lugs are provided on the framing of the bogie to enable a loaded pallet to be moved by a tow-truck where space or headroom is too limited for the fork-lift truck to manoeuvre.

Of all-welded construction, the steel frame is suitably braced to ensure maximum rigidity. All rollers are of the wide-tread type, machined from steel bar and fitted with alloy steel roller bearings. The main running rollers are arranged in pairs and mounted on a slightly lower plane than the corner rollers so that the bogie can pivot freely, through 360 deg if required, for positioning. The standard model illustrated is designed to carry the popular-sized 40 in \times 40 in pallet. Other sizes can be supplied by the manufacturers, Powell and Co., Burry Port, Carmarthen, South Wales.

Electrodes for gouging and piercing

An entirely new type of electrode, designed specifically for grooving, gouging and piercing operations or for removing surplus metal, has been introduced by the Welding Electrode Division, The English Electric Co. Ltd., Clayton-le-Moors, Accrington. Known as "Groovees", these electrodes can be used with ordinary A.C. or D.C. welding plant without additional equipment or oxygen or air supplies. They leave a clean, scale-free surface on the work that requires no further preparation before re-welding.

In some commonly used methods of gouging, a carbon electrode is used with a supply of either oxygen or air. With those processes there is an obvious risk of the work picking up carbon from the electrode and forming hard zones adjacent to the groove or the pierced hole. This can conceivably cause cracking on re-welding. Groovees, however, have a mild steel core wire and, as there is no carbon present, there can be no chance of carbon pick-up.

For cutting grooves, the new electrode is held at an angle to the work surface, pointing in the direction of travel. After an arc is struck, the electrode is moved rapidly along the line to be cut. The force of the arc cuts the groove and removes the molten metal, leaving a clean bright finish. When gouging-out defects in castings, a series of overlapping grooves are cut in alternate directions. It is possible to remove a

defect of considerable depth. To pierce holes or remove rivets, the electrode is held perpendicular to the workpiece. The arc is struck and held until the metal flows, and then the electrode is moved into the molten pool. With manipulation, holes up to $\frac{3}{4}$ in diameter can be pierced in plate up to $\frac{1}{2}$ in thick. Rivets can be removed from much thicker plate.

Groovees, which are supplied in two standard sizes, 10 S.W.G. and 8 S.W.G., are equally effective on all steels, cast iron, and non-ferrous metals. They have been used successfully for cutting thin sheets of non-ferrous metals and for cutting stainless steel plate $\frac{3}{16}$ in thick.

Smaller and lighter electric motors

For nearly a quarter of a century there has been little change in the design of electric motors but in 1957 a major step was taken on the introduction of the new British Standard Draft Specification C.W. (Ele.) 6426 for dimensions and the amended B.S. 2613 for electrical performance with class "E" insulation. By the use of new insulating materials, improved ventilation and compact design, the performance of a currently conventional motor can be matched by a unit of approximately only 75 per cent of the present size, and cost will be materially reduced.

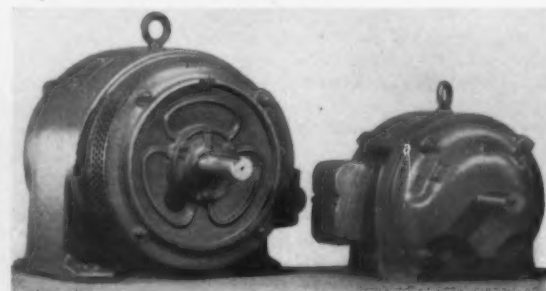
Brook Motors Ltd., Huddersfield, is now producing a range of motors, designated "C" type to differentiate from the earlier "R" type units, having outputs of from $\frac{1}{2}$ h.p. at 750 rev/min to 50 h.p. at 3,000 rev/min.

Particular care has been given to the design of the ventilation system. The cooling air is drawn into the ends of the motor, guided by pressed steel air deflectors which provide additional protection for the end windings, passes over the windings, and is expelled through openings in the yoke casting. Former British Standard Specification 168 permitted a maximum temperature rise of 40 deg C. which allowed for sustained overloads. The newly amended B.S. 2613, permits a maximum temperature rise of 65 deg C under continuous maximum rating conditions. Exhaustive tests have been run on prototypes of the new motors with Class "E" insulation. Better starting performance has been obtained and also remarkably cool running, well below the limits imposed with full output. In many instances, tests show a temperature rise close to the previous standard, and the motor will exceed in performance all previous ventilated machines of equal rating.

The terminal box is of cast iron with ample space for connecting the power cables to the moulded plastics terminal board. The box can be rotated to four positions, as also can the endshields, making the motor adaptable for mounting on floor, wall or ceiling while retaining the full protection of the drip-proof design.

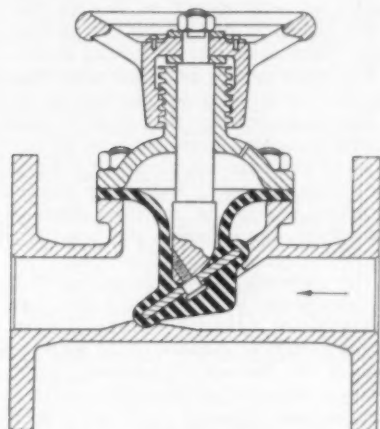
Rotors of pressure-cast aluminium with integral fans are mounted on shafts of 40-ton tensile steel, and the whole shaft

Brook "C" type A.C. motor. On left, earlier "R" type motor of equivalent output
Brook Motors Ltd.



assembly is dynamically balanced to ensure quiet running on pre-loaded medium ball bearings.

The new motors are more compact in size, easier to fit in confined spaces, lower in weight-for-size ratio, and most important, lower in first cost. In the illustration, the 7½ h.p. "R" type motor, the standard product for many years, is shown on the left for comparison with the new "C" type motor of equivalent power output.



"Rayon-Patent" stop valve
Meynell and Sons Ltd.

Diaphragm-type stop valves

An extensive range of "Rayon-Patent" stop valves, suitable for controlling the flow of almost any fluid or gas at temperatures up to 100 deg C, has been introduced by Meynell and Sons Ltd., Montrose Street, Wolverhampton. The outstanding feature of these valves is a resilient diaphragm, the peripheral margin of which is clamped between flanges on the necked body and the domed cover. Thus, the control mechanism is isolated from the working fluid and the need for a spindle packing gland is eliminated.

A moulded central boss of the diaphragm forms the valve clack and engages an angled seat in the valve body. When the clack is seated the remainder of the diaphragm is relieved of all fluid pressure. Should a leak occur in the diaphragm after extremely long usage, it will be revealed by escape of fluid through the vent hole in the cover, and loss of fluid can be prevented by closure of the valve.

The clack is well supported on a metal disc attached to the angled end of the slidable but non-rotatable spindle. Freely rotatable on the shouldered spindle, the control handwheel has an internally threaded hub engaging the square-threaded spindle boss on the cover. The position of the hub relative to the cover gives a clear indication whether the valve is open or closed.

To meet differing conditions the valves can be supplied with bodies of cast iron, S.G. iron, bronze, zinc-free bronze, or aluminium alloy, and can be lined with natural or synthetic rubber, plastics, or lead. They can thus be produced in types suitable for handling acids, corrosive fluids or process fluids as required. Lined versions can be used in applications normally calling for costly valves in stainless steel and also for the control of vacuum. A nylon clack has been developed for handling petrols, oils and solvents that adversely affect natural and some synthetic rubbers.

Valves are produced with screw connections from ½ in to 2½ in B.S.P. and with flanged connections for from ½ in to 6 in diameter pipes. Rated working pressure is up to 220 lb/in² for the smaller size, but this figure is progressively reduced as the size is increased.

Vertimax production lathes

These vertical spindle chucking lathes are now made in a range of three sizes, designated Models 2, 3 and 3A. Model 2, with a 12 in diameter, air-operated chuck, can swing 21 in diameter below the 5 in travel tool slides and is driven by a motor of from 10 h.p. to 15 h.p. On Model 3 the chuck may be either 15 in or 20 in diameter and the maximum swing under 8½ in travel tool slides is 24 in diameter. The driving motor is from 25 h.p. to 30 h.p. This machine, equipped with a 12 in chuck, 5 in stroke tool slides and a 15 h.p. motor become Model 3A. In each instance a choice of three ranges of spindle speeds is available using a standard set of quick-change, pick-off pulleys.

To ensure maximum rigidity when taking heavy cuts, or when using multiple tools, the spindle is carried in high-precision Timken roller bearings in a large diameter steel housing. Final drive to the spindle is by Renolds Triplex chains. Standard cutting tools can be used in the two independently adjustable tool slides. Each slide is mounted on a radial arm supported on a pneumatically balanced, vertical steel column and rigidly located by adjustable out-board brackets. The slides can be swivelled from below the horizontal to beyond the vertical position and also swung through 90 deg on an eccentric mounting. Both movements are adjusted by worm and wheel.

Independently controlled, steplessly variable hydraulic feed is provided for each slide and built-in tool relief mechanisms are of the cartridge type that can be reversed to suit the direction required for either boring or turning operations. Combined with the tool relief valve is a feed pulse mechanism. Efficient chip breaking can be obtained under a wide variety of operating conditions without the need for special tool grinding. Pulsation does not affect the set cycle time. Rapid-approach cams, adjustable for point of change from approach to feed rates, reduce idle time to a minimum and positive dead stops on the slides ensure maintenance of size.

The machines are manufactured by Vertimax Ltd., Glasgow, a company of the Charles Churchill group. Distributors in Britain are Charles Churchill and Co. Ltd., Coventry Road, South Yardley, Birmingham.

Tool arrangement on Vertimax production lathe
Charles Churchill & Co. Ltd.



VAPORMATIC RHEOSTAT

A Compact and Inexpensive Automatic Starter for Slip-Ring Electric Motors

OWING to the wide variety of requirements for starters for electric motors used in industry, each unit has hitherto had to be specially made to suit the installation for which it is used. This, of course, applies to the conventional stepped-resistance type of starter; however, a new unit, the Vapormatic rheostat, recently introduced by Lee Guinness, Ltd., of Newtownlands, Northern Ireland, is designed to overcome the problems with regard to rationalization of this type of equipment, and it also has a number of other advantages. One of the principal claims is that the Vapormatic rheostat provides for automatic starting at a cost approximately the same as that of hand starting equipment.

Advantages

The main advantages claimed for the new unit are as follows. It is exceptionally sensitive to the varying demands of the motors to which it is applied, and thus gives smooth acceleration and obviates shocks, such as are encountered in the stepped-starting systems. This prolongs the useful life of the motor. The Vapormatic unit regulates the rotor current to suit the starting conditions and, on completion of the start, it automatically cuts out. Since the resistance is automatically varied to suit any condition of load, the unit

is remarkably flexible and a degree of standardization hitherto unknown with regard to starters for slip-ring motors is now possible. In fact, the new unit is made in only one size, which is suitable for starting motors of up to 40 b.h.p. For larger motors, additional units are connected in parallel, one for each further increase up to 40 b.h.p. This is an important advantage, because only a small stock of spare Vapormatic starters is needed to cover all requirements. Therefore, so far as starters are concerned, new plant can be installed at a moment's notice and, should any breakdowns of starters occur, they can be remedied immediately by a simple replacement, the defective unit being repaired and replaced in stock.

Among the economic advantages of the unit are the following. Vapormatic starters are less than half the size of most conventional automatic starters of equal capacity for slip-ring type motors. Because of the simple and robust construction of the rheostat, maintenance costs are low. The Vapormatic starter is considerably lower in price than conventional automatic starters. It is stated by the manufacturers that owing to the high degree of rationalization possible with Vapormatic starting equipment, they are able to offer an extremely good delivery service.

Principle of operation

In its simplest form, the invention consists basically of an apparatus incorporating two electrodes adjacent to one another in a small chamber of insulating material. This chamber is submerged in a tank of electrolyte, the liquid being free to flow through orifices into the chamber. The size of the orifices is such as to offer a predetermined resistance to the flow of the liquid.

When a high current is passed through the electrodes, the resistance of the electrolyte causes local heating. This leads to almost instantaneous vaporization of the liquid between the electrodes. As a result, the liquid is driven out of the chamber, which then contains only vapour. In this condition, the resistance in the circuit is at its maximum.

Vaporization takes place, of course, only when the current passing across the chamber exceeds a certain critical value. Above this critical value, the rate of vaporization bears a direct relationship to the current. Consequently, if the current diminishes progressively from a value well above the critical point to one below it, the chamber, which initially was full of vapour, progressively fills with liquid, and the resistance in the circuit is correspondingly reduced from the high value, with the chamber full of vapour, to the low value, with the chamber full of liquid. The ratio of the resistance of the vapour to that of the liquid is approximately 50:1.

Description of the unit

The accompanying illustrations show the general arrangement of the Vapormatic rheostat. From these illustrations, it can be seen that the unit consists of a cylindrical tank containing the electrolyte; three electrodes suspended from a circular upper plate of insulating material; and a neutral or star point, of hexagonal section, in an electrode chamber of Steatite.

In the electrode chamber, there are three compartments, each of which contains the lower end of one electrode and one segment of the star point. Orifices in the sides of the

These presses, in the Renault factory, are all equipped with Vapormatic rheostat starters. The degree of compactness obtained in the design of these starter units can be seen by comparing the size of the one in the foreground with the man standing with his right hand touching it.



compartments enable the electrolyte to pass from the tank into the chamber. The volumes of the compartments and the areas of the electrodes can be regulated, to suit the starting conditions of the motor, by fitting nylon inserts between the electrodes and the star point. These inserts are located between nylon caps, held in position by the top and bottom covers of the electrode chamber.

A double-pole air-break contactor and a Thermistor are mounted above the circular plate of insulating material. The Thermistor is calibrated to operate the contactor and short-circuit the rheostat at the end of the starting cycle. A cover is fitted over the top of the whole assembly to protect the contactor, Thermistor and main terminals.

Operation

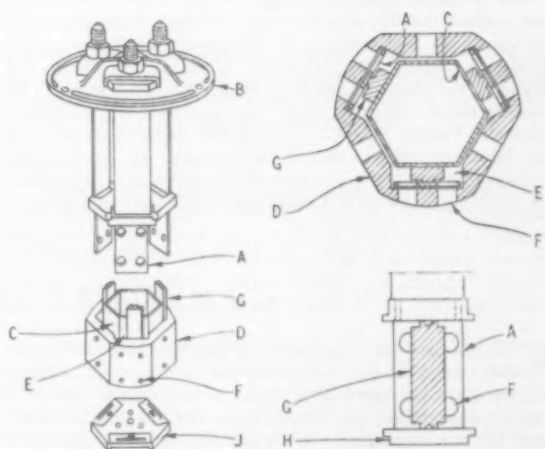
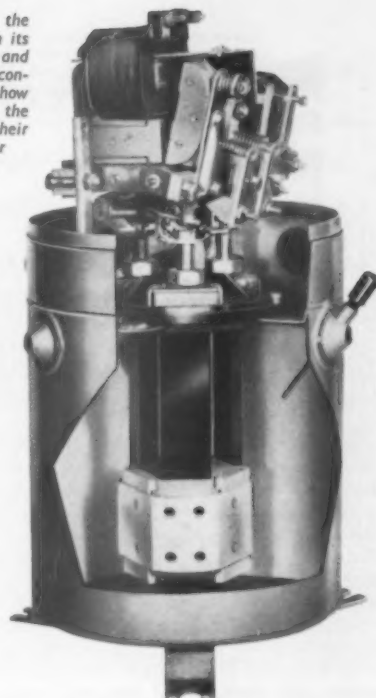
The rheostat is connected into the rotor circuit of the slip-ring motor in such a manner as to form the star point. When the stator of the motor is connected to the line, the current induced for each phase of the rotor passes down the electrodes, across the gaps containing the small volumes of liquid electrolyte in the three compartments of the electrode chamber, and thus to the star point. At the moment of starting, the current induced in the rotor circuit is much higher than the critical value, and therefore the liquid electrolyte between the electrodes and the star point vaporizes almost instantaneously. In this condition, the resistance in the circuit corresponds to that of the electrode chamber filled with saturated vapour.

As the motor accelerates, the rotor current gradually decreases. Therefore, the rate of vaporization also decreases and the liquid electrolyte tends to return progressively to the chamber, the expelled vapour being condensed in the main volume of liquid in the tank. The resistance in the rotor circuit is directly proportional to the ratio of liquid to vapour in the electrode chamber and is therefore reduced in direct relation to the rotor current.

When the starting cycle has been completed, the electrode chamber is once more full of liquid electrolyte, the conductivity of which is sufficient to carry the full load current of the rotor. This current, of course, is below the critical value of the apparatus, so further vaporization does not take place. In these circumstances, the resistance of the circuit is at its minimum. When the starting cycle is complete, the rheostat is automatically short-circuited by the contactor.

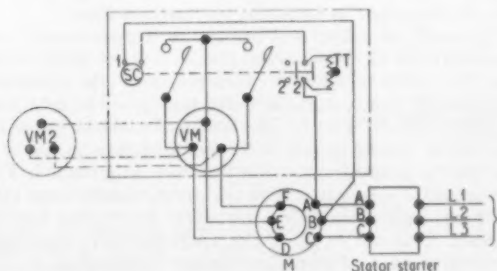
The way in which the resistance varies during the whole of the starting period is shown in the accompanying graph. Oscillographs are also reproduced to show some of the results of tests carried out on Vapormatic units at the A.S.T.A. testing station of Crompton Parkinson, Ltd. From these illustrations, it can be seen that the claims, to

An illustration of the Vapormatic unit with its top cover removed and with the cylindrical container sectioned to show the arrangement of the electrodes and their three-cell chamber



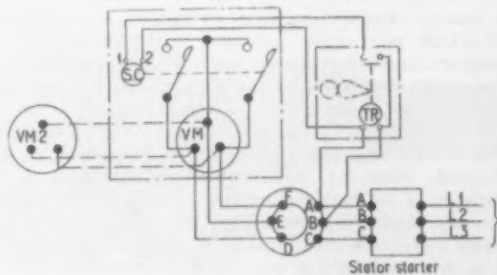
Below: Diagrammatic illustrations showing the starter circuits; left, with a Thermistor timer and, right, with a timing relay incorporated

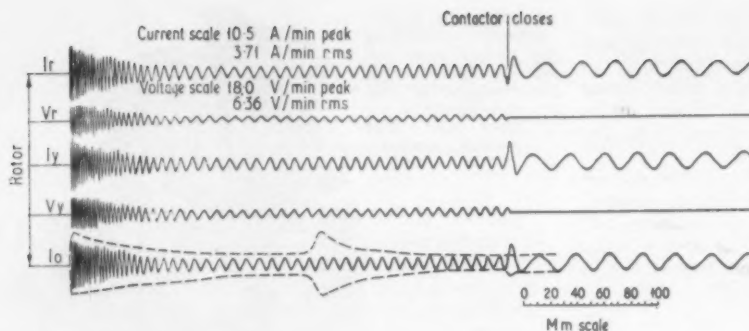
- | | |
|------------------------------|---|
| M motor | SC shorting contactor |
| TR timing relay | TT Thermistor timer |
| VM Vapormatic starter | VM2 second Vapormatic, if required |



Above: Diagram showing the arrangement and some of the details of the electrodes, the star point, the chamber assembly, and nylon inserts

- A** electrode; **B** mounting plate, of insulating material; **C** neutral, or star point; **D** electrode chamber; **E** one of the three compartments for the electrodes; **F** calibrated orifices; **G** nylon insert; **H** nylon cap; **J** electrode chamber cover



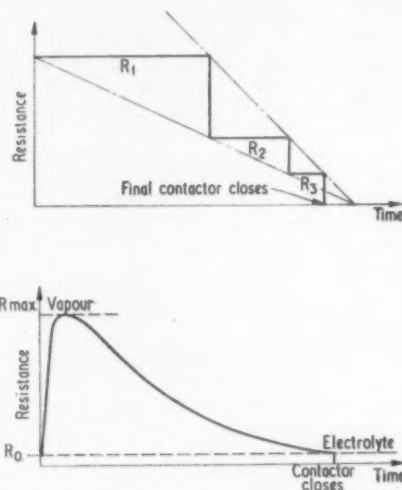


Copy of oscillographs, showing some of the curves of the results obtained in the tests that were carried out on Vapormatic starters at the A.S.T.A. testing station of Crompton Parkinson Ltd., at Writtle Road, Chelmsford

the effect that the resistance reaches its maximum value almost instantaneously and then is progressively reduced, are justified.

To reduce to a minimum the rate of evaporation of electrolyte, the surface of the liquid is covered with oil. Nevertheless, it has been found that topping-up is required at a rate of approximately half a pint of water every three months. Tap water is perfectly satisfactory for this purpose. The electrolyte used varies according to the application, but is generally a solution of potassium or sodium, carbonate or hydroxide. The unit will operate satisfactorily until the temperature of the liquid rises to about 80 deg C, so it is suitable for use for most normal applications. However, if the frequency of starting is very high, it cannot be used to replace the conventional step type unit. Its dimensions are 18 in high x 9 in diameter.

Lee Guinness Ltd., have acquired rights, to manufacture and market the Vapormatic unit, from the Association des Ouvriers en Instruments de Précision, in France, and Monsieur Bérard, the inventor. This licence covers the whole of the British Commonwealth, except Canada. The manufacturers state that units can be supplied immediately from the French factory, but they will be in production in the Northern Ireland factory in a month or so. A new factory, of 55,000 ft² is also being built and there is provision for doubling that area in a short time when the need arises.



These two diagrams illustrate the starting characteristics of the Vapormatic rheostat and those of a conventional stepped starter unit; comparison of the two shows clearly the advantages of the new Lee Guinness unit

EMPLOYEE INTERVIEWING

FOR the past five years, the Department of Industrial Administration of the Birmingham College of Technology has conducted a two-week summer school on the subject of employee interviewing. This school is held in June, after the work of the normal session has ended. The methods employed are based on the Five-Fold Grading of human attributes and the Biographical Interview. Of these two bases, the former provides a framework on which the demands of a job and the potentialities of the individual can be set out in comparable terms. The biographical interview enables the trends in an individual's behaviour to be discovered and interpreted so as to give an indication of what can be expected of him in the future.

A number of studies of interview judgements so formed have already been made, and have shown that two interviewers working independently arrive at similar conclusions. These results show agreements which, it is claimed, indicate a high degree of effectiveness of the methods in practice. Past students are being kept in touch with the Department and with each other, so that views and experience can be exchanged. Some field studies have been carried out on the application of the methods taught in the school to the actual selection problems in industry and, it is claimed, a generally accepted useful code of common practice suitable for application in industry is now in the process of being built up.

It would, of course, be unrealistic to expect fine limits of accuracy in the summing up of individuals, since no method of selection is foolproof. Moreover, the effectiveness of the method depends to a great extent on the competence of the person applying it. However, interviewers trained in the methods taught on the course appear to be both consistent and successful in summing up applicants for jobs.

The school is held in the new college at Gosta Green. Unfortunately, only a limited number of students can be accepted. Practical work, in the form of demonstrations, case studies, and practice in interviewing, forms an essential part of the course. Also, a visit to a local works is arranged, for the purpose of practice in preparing job specifications.

This year, the school will be open to managers and their assistants from all departments, that is, it is not restricted to those departments directly concerned with the personnel function. A special course in ability testing will be held concurrently with the school. The intake of students has so far been almost wholly limited to the Birmingham area, but it is now felt that people from a wider field may be interested. The next school, it is hoped, will be held from Monday June 16th to Friday June 27th, 1958. Details of the courses may be obtained from the head of the Department of Industrial Administration, College of Technology, Birmingham 4.

HANDA OVERDRIVE

A Unit Designed to Appeal to Those Whose Prime Requirements Are Simplicity of Construction and Ease of Installation

OVERDRIVE units are undoubtedly becoming increasingly popular, but the main problem for those who have to manufacture and sell them is, of course, that of keeping the costs of production and installation to a minimum. Handa Engineering (London) Ltd., claim to have solved these problems with the Handa overdrive. This unit undoubtedly is of simple construction, comprising only one planetary gear train, and a dog clutch and its vacuum-actuated operating mechanism. Another advantage claimed is that the unit has been designed specifically for the range of vehicles that is most popular in this country and in Europe generally. The sole sales concessionaires are Vehicle Developments Ltd., of 60 Balcombe Street, London N.W.1.

Among the vehicles to which this overdrive can be fitted are the Vauxhall Victor, Velox and Cresta, and the Ford Anglia, Prefect, Consul and Zephyr models. In direct drive, the dog clutch connects the sun wheel to the planet carrier, so that the planetary train and input and output shafts are locked together. When the control is moved to give overdrive operation, the clutch first disengages the sun wheel and planet carrier and then moves over further, to hold the sun wheel stationary by locking it to the casing. The overdrive ratio is 0.743:1.

Since the unit is mounted immediately behind the gearbox, the number of gear ratios obtainable without the overdrive fitted is doubled when the unit is installed. The change to or from overdrive is effected simply by movement of a push-pull control knob, which, in the Victor, for example, is mounted on the dash fascia, but which can be mounted in any convenient position.

There are, of course, different ways in which the overdrive unit can be operated. One is to move off from rest in first overdrive and to change up, with the normal gear lever, to second and third overdrive ratios in turn. Thereafter, changes down for overtaking can be made either by operating the overdrive control to select direct drive, or by the use of the gear shift lever in the normal manner, that is, as if the overdrive unit were not there.

There is no need to use the clutch for changes into or out of overdrive. The driver first makes sure that the engine is pulling and then operates the control knob. If he is changing up, he pauses for a fraction of a second after operating the knob, then releases the throttle pedal. A whirring sound is heard as the teeth of the dog clutch synchronize their speeds; as soon as this stops, the throttle can be opened again and the drive taken up. The change down can be effected more



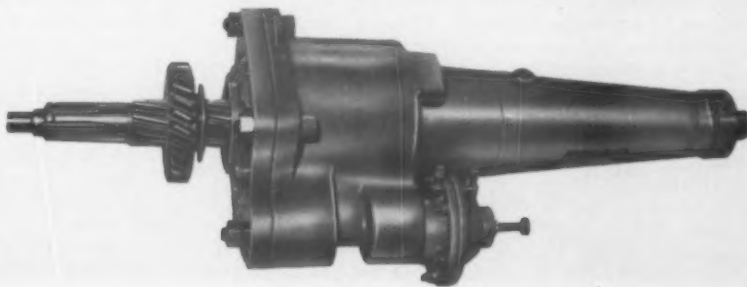
Principal components of the dog clutch. The teeth are chamfered to enable them to ride over one another until synchronization has been effected and the vacuum control can complete the engagement motion

quickly: again, the engine is kept pulling while direct drive is selected, but after a fraction of a second, a momentary easing of the throttle pedal causes direct drive ratio to be selected and the drive is immediately taken up again.

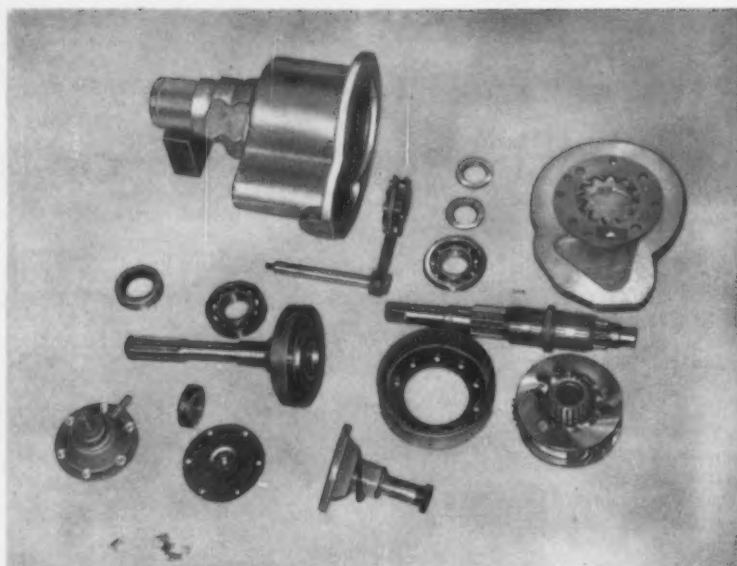
Arrangement of the unit

The unit comprises two main assemblies mounted one above the other in the casing. Of these two, the upper one is the planetary gear train and the clutch, while the lower one is the vacuum control for the clutch. The illustration is that of the overdrive for the Vauxhall Victor. In this unit, helical gears are employed, whereas in some of the others, straight spur gears are used.

As can be seen from the illustration, the tail end of the gearbox mainshaft is modified to carry a phosphor bronze bush, on which the sun wheel is free to rotate. It is also shortened, and its end is machined down to hexagonal form to receive the planet carrier. The gears are of En 352, case hardened to 0.005 in on their teeth. Hoffmann B1649 pins carry the planet pinions, which are mounted on Torrington B812 needle rollers. All the clutch rings are of En 36, case hardened to a depth of 0.030-0.040 in, and the sliding component of the clutch, which is also of En 36, is case hardened to a depth of 0.040-0.060 in to give adequate wear resistance.

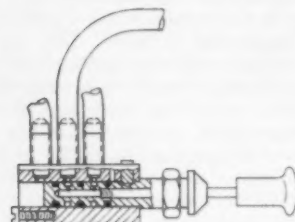


The Handa overdrive unit has been designed in such a way that it can be readily installed by any normally-trained, competent mechanic



Left: Simplicity, and therefore low cost, is one of the principal features of the design of the Handa overdrive unit

Below: A cross section of the push-pull vacuum control, which in most applications is mounted on the dash facia



The sliding member is carried on splines on the forward end of the sun gear and it has two rows of teeth round its periphery, the rows being separated by the groove for the selector fork. For direct drive one row of teeth engages the clutch ring riveted to the front face of the planet carrier, thus locking the carrier to the sun wheel. When the sliding component is moved forwards, out of engagement with this ring, the planetary gear assembly is freed; then further movement causes the other row of teeth to engage the teeth of the second ring, which is an anchor plate bolted to the gearbox. This locks the sun wheel to the anchor plate and gearbox, to give overdrive.

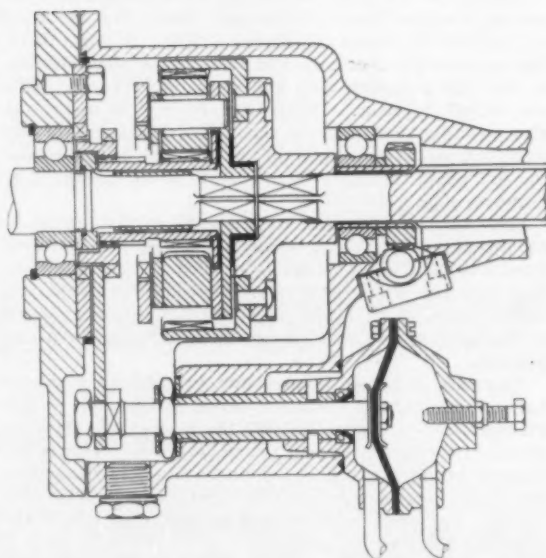
An En 352 annulus is employed. It is spigoted on to a boss and secured by ten $\frac{1}{4}$ in diameter rivets. This boss is mounted on the hexagonal forward end of the output shaft. Phosphor bronze thrust washers are interposed between the forward face of the boss and the planet carrier, and also between the planet carrier and a thrust ring spigoted on to the rear end of the sun wheel. Another boss is formed at the centre of the rear face of the planet carrier; it spigots into a phosphor bronze bush, housed in a counterbore in the centre of the front face of the boss that carries the sun wheel.

Immediately behind the boss, on which the annulus is mounted, the shaft is carried by a Hoffmann RLS8 ball bearing in the overdrive casing. The speedometer drive gear is mounted behind this bearing, and the remainder of the shaft is splined to receive the sliding joint. In the rear end of the extension of the housing, the steel-backed, white metal bush and the seal of this overdrive are common with those used on the standard gearbox.

Vacuum control

The vacuum control unit is designed so that the standard A.C. diaphragm can be employed. This diaphragm is bolted to one end of a case hardened En 36 spindle. The spindle is carried in a sleeve, one end of which is cast in and pinned to the vacuum control unit casing. A ring nut is screwed on to the other end of the sleeve to secure the whole assembly in the hole drilled in the overdrive casing. As this nut is tightened against the inner face of the casing, it pulls the sleeve and control assembly against a circular section sealing ring housed in a V-groove round the counterbore in the outer face of the casing. The nut is locked by a Shakeproof washer.

Another nut, on the $\frac{1}{2}$ in diameter threaded end of the spindle, pulls the En 352 selector fork against a collar formed



Longitudinal section, showing the general arrangement of the overdrive unit and its vacuum control, with the dog clutch in the overdrive position

on the spindle. Interposed between this collar and the nut that secures the sleeve and control assembly to the overdrive casing is a distance washer, by means of which the mesh of the direct drive clutch is adjusted. At the other end of the control assembly, there is a set screw and lock nut. This screw can be used to lock the unit in overdrive, should the vacuum control fail.

Operation of the control, which is of the simple slide valve type, admits vacuum to one side of the diaphragm and connects the other side to atmosphere. This causes the spindle to be moved axially either rearwards to engage the direct drive clutch or forwards to engage the overdrive. Lubrication of the overdrive assembly is effected by splash, there being a duct through which oil can pass between it and the gearbox. Thus the oil level in the overdrive unit is the same as that in the gearbox of the normal transmission system of the vehicle.

WORK-LOADING DEVICES

Developments to Increase Output From Wickman Chucking Automatics

FOR many components, multi-spindle automatic lathes will give higher output rates and more economical production than any other type of machine. This is particularly true of bar automatics, which are capable of cycle times in the order of two seconds per piece. Output from multi-spindle automatics has hitherto, however, been restricted by the need to unload, reload and start the machine by hand. Because of this, the floor-to-floor time per piece could be greatly in excess of the actual machining cycle time. In addition, each machine required an operator.

Obviously, the elimination of hand loading and unloading for multi-spindle chucking automatics is highly desirable. Machines equipped with automatic loading devices have greater flexibility and greatly increased production potential, since they can either be incorporated into line production systems or, when used as single units, be group-fed by one operator. Developments in machine tool design and improvements in tooling have already reduced machining cycle times to a point where hand loading is completely uneconomical. In these circumstances the use of fork-handling devices not only speeds up production but also provides the possibility of full machine utilization for multi-spindle chucking automatics.

Work-handling devices for chucking automatics may broadly be divided into two classes. The larger of these is that in which a fixed storage chute is used in conjunction with a swinging transfer arm. The components are stored in the chute, which has a trip mechanism to allow one component at a time to progress to the position of readiness at the end of the chute. From this position the transfer arm picks up the component, swings to a position opposite the loading station, and then advances longitudinally to place the component in the open jaws of the chuck, and the chuck then closes auto-

matically to secure the work. To unload the machined part, the transfer arm advances again and picks up the component as the jaws open, then retracts further, before swinging back to place the machined part in an ejection chute, frequently with the help of a stripper.

A typical development by Wickman Limited, of Banner Lane, Tile Hill, Coventry, is shown in Fig. 1. In this application the attachment is fitted to a Wickman 7½ in—6 chucking automatic. It incorporates all the features mentioned in the preceding paragraph. The storage chute is in two parts; a primary chute A, which is connected, by the turntable B, to the secondary chute C. Castings pass one at a time on to the turntable and thence down the secondary chute to the readiness position. From this position, the cam-actuated transfer arm D picks up the component, gripping it internally by means of an air-operated expanding collet, and advances it to the machine chuck.

To unload, the arm picks up the machined part from the open chuck, then retracts until it is in line with the ejection chute F and swings back to place the component in this chute. In this application, a stripper E is provided to assist in the removal of the component and guide it into the chute proper. The size and weight of the component require that many of the auxiliary operations be performed by compressed air, and cam-operated valves are used to actuate the movements. The trip and turntable mechanisms and the expanding collet are all operated by compressed air, a method that has been found highly reliable for handling relatively large components.

A similar device for handling a very much lighter component has been fitted to a Wickman 6 in chucking automatic. It is illustrated in Fig. 2. In this application the component is smaller than that handled in the previous example. An

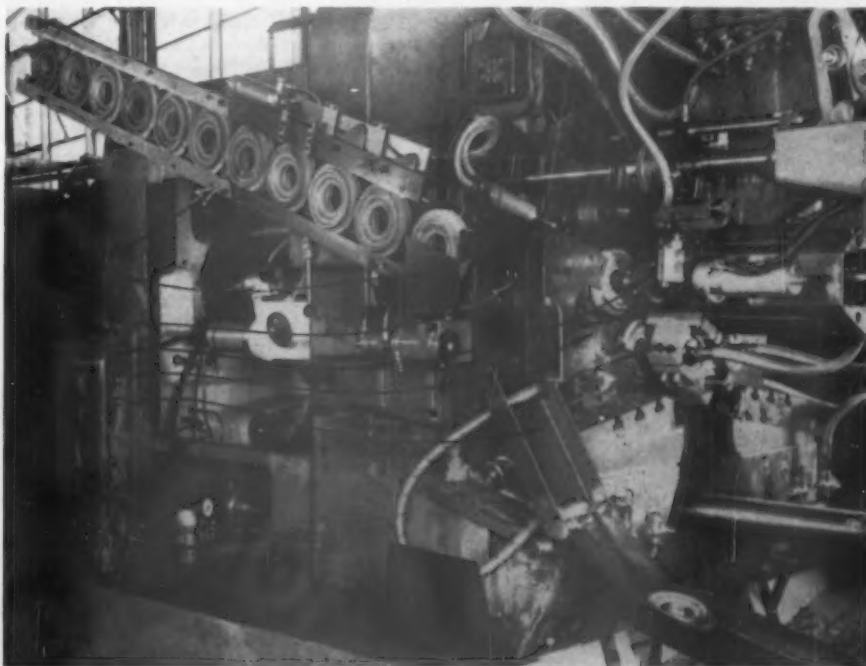
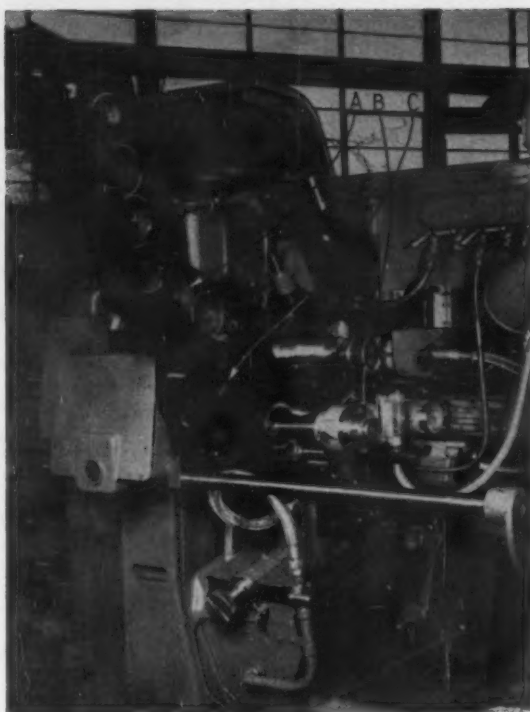


Fig. 1. Wickman multi-spindle chucking automatic with transfer arm attachment for loading heavy castings

A primary chute; B turntable;
C secondary chute; D transfer arm;
E stripper; F ejection chute



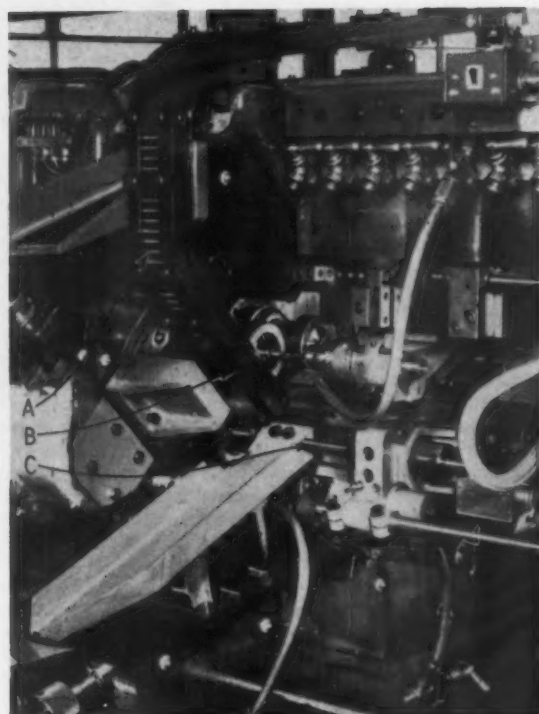
A loading chute; **B** transfer arm; **C** ejection chute and stripper
Fig. 2. Transfer arm loading attachment for handling light aluminium castings

external chuck with three spring-loaded fingers is used on the transfer arm B, while the machine chucks are of the three-jaw, internal expanding type.

Essentially, the procedure is the same as that described for the previous example. The arm picks up the component from the end of the loading chute A and then places it in the chuck at the loading station. After the component has been machined, the arm removes it from the same station and, with the aid of a stripper, places it in the ejection chute C. In this case the component is a light aluminium casting; the loading chute is therefore so designed that the workpiece is never allowed to fall any distance that might crack or distort it. The action of this work-handling device is completely

Fig. 3. Simple all-mechanical transfer loading attachment for gear blanks

A loading chute; **B** internal collet and sleeve; **C** transfer arm



A fixed loading chute; **B** moving loading chute; **C** loading plunger
Fig. 4. Chute and plunger device for loading cast iron stick

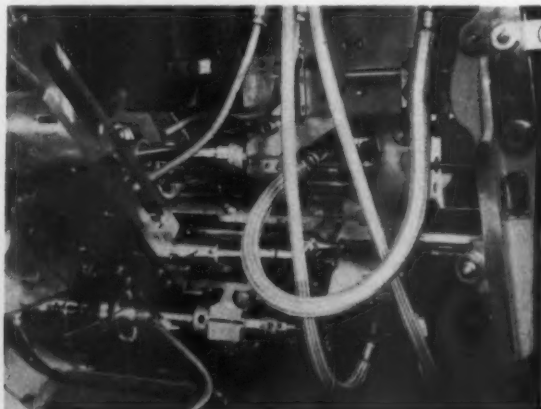
mechanical, with a few electrical limit switches fitted as safety devices.

Another example of this type of loading attachment is shown in Fig. 3, which shows the loading chute A, an internal collet and sleeve B, and the transfer arm C. In this application, the operation of the internal collet on the transfer arm is such that a stripper is not required. The component, a gear blank, is such that trip mechanism is not necessary in the chute, one component falling into the readiness position as soon as the arm removes the preceding one.

The collet is a push-fit in the bore of the gear blank and, in conjunction with the transfer arm, it picks up the component, loads it and then retracts in the usual way. For unloading,

Fig. 5. Simple chute and plunger device for handling gudgeon pins

A loading chute; **B** loading plunger





A hopper; B loading chute; C loading plunger

Fig. 6. Hopper feed device for small cylindrical workpieces

the collet picks up the machined part, the arm retracts and swings to bring the component to a position over the ejection chute. As the arm finally reaches this position, a plunger on the back impinges against a special stop. This forces a sleeve over the collet, and the component is thus pushed off the collet. At all other times the collet is uncovered ready for handling the component.

The type of attachment shown in Figs. 1, 2 and 3, is generally more suitable for handling heavy or bulky components. For lighter or smaller work, and especially cylindrical

parts, the type illustrated in Figs. 4, 5 and 6 is usually more suitable. This type differs from that already described mainly in that the storage chute moves, usually making use of the cross slide movement, to bring the component into the readiness position exactly in line with the chuck at the loading station.

Loading is carried out by the action of a plunger, usually driven by a standard independent attachment similar to that used for reaming, which pushes the component into the chuck. The component is generally ejected by a spring-loaded plunger in the centre of the chuck. This system is often used on bar machines that have been converted to chucking operations, because the existing bar feed mechanism can be used to actuate the ejection plunger.

Fig. 4 shows a Wickman 1 in—6 bar automatic that has been successfully modified for chucking operations to deal with small individual workpieces, in this case ground cast iron sticks. It also demonstrates how automatic loading speeds up production and eliminates operator fatigue and the delays that occur with hand loading.

On this machine the storage chute is in two parts, a fixed part A and a moving part B. The portion B is attached to and moves with the machine cross slide, to bring the bottom component into the readiness position. A loading plunger C, driven by a standard independent reaming attachment, then pushes the component into the chuck. Ejection of the machined component is effected through the machine's bar feed mechanism acting on another plunger inside each chuck.

The simplicity of this arrangement, together with the fast cycle time of 11.2 seconds, allows a very high rate of production to be maintained. When the cycle time is as short as this, it is important to have a storage chute of as large a capacity as possible, in order to avoid having to re-load at too frequent intervals. In this example, maximum capacity in minimum space has been obtained by extending the chute over the top of the machine so that loading is done from the back. This chute holds 80-100 workpieces; this gives from 15 to 18 minutes between refills of the chute.

A similar arrangement, in this case for handling gudgeon pin blanks, is shown in Fig. 5. There is, however, this difference; the whole of the storage chute A is attached as a single unit to the cross slide. The loading plunger B is again driven by what is basically the independent reaming attachment at station 5. Another method of storing the workpieces is shown in Fig. 6. The component is again a gudgeon

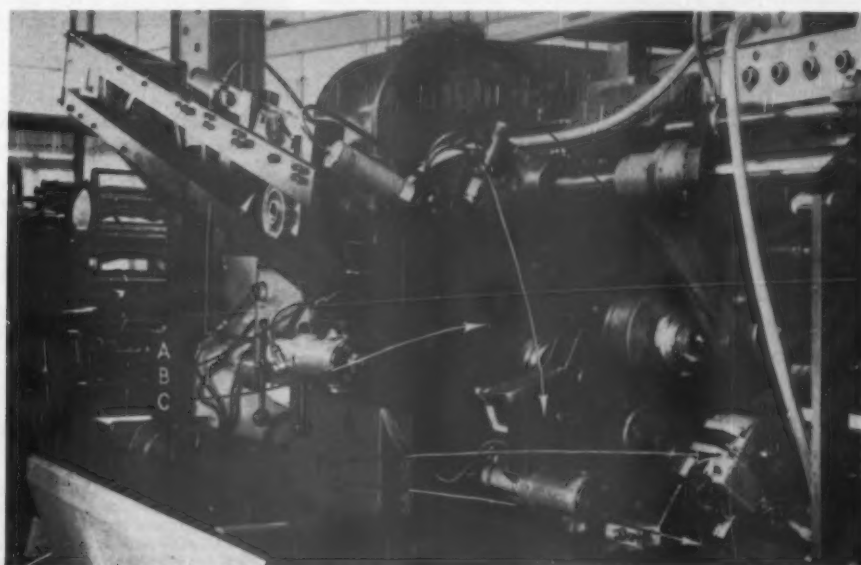


Fig. 7. Wickman chucking automatic arranged for automatic loading and unloading. The component is machined on both sides in one machine cycle

A primary loading chute; B 90 deg turntable; C secondary loading chute; D first transfer arm; E 180 deg turntable; F second transfer arm; G ejection chute

pin, although a much smaller one than that dealt with on the machine shown in Fig. 5. In this example, the attachment, while generally similar to that illustrated in Fig. 5, incorporates a hopper A, with only a short loading chute B. This arrangement gives a large storage capacity without extending the loading chute and enables the whole unit to be attached to the cross slide. The loading plunger is shown at C in the illustration. As trigger mechanism is not necessary for this component, the whole arrangement is one of the simplest possible.

As an example of a highly complex loading and unloading attachment, with auxiliary equipment that makes it a true work-handling device, the arrangement shown in Fig. 7 is worthy of attention. The problem was that of machining both sides of a relatively heavy cast iron workpiece in one machine cycle. The machine is a Wickman 6½ in—6 chucking automatic, modified to double indexing. This means, of course, that each spindle indexes two stations at a time, thus giving two separate machining sequences, each using two tooling stations. The remaining two stations are used for loading and unloading. To avoid delays in the sequence, the

component had to be reversed automatically before it passed from the first operation to the second.

The sequence of operations is as follows. From the primary loading chute A, the part passes to a 90 deg turntable B, and thence by the secondary chute C to the readiness position for the first machining operation. A swinging transfer arm D then loads the part into the chuck at station 5. Machining is then carried out at stations 1 and 3, following which the transfer arm D unloads the piece at station 5 and places it on a 180 deg turntable E. This turntable reverses the part and brings it into position to be picked up by a second transfer arm F for loading into the chuck at station 6. The other side of the component is then machined at stations 2 and 4. Finally, at station 6, the workpiece is removed from the chuck by transfer arm F, which has longitudinal motion, and placed in the ejection chute G.

In order to keep the two loading stations clear, it was necessary to carry out 19 operations at only four stations. This, of course, called for very careful tooling. The cycle time for the whole operation, that is, machining both sides, is 30 seconds; this includes all the loading and unloading time.

Recent Publications

Brief Reviews of Current Technical Books

Servicing Guide to British Motor Vehicles, Vol. IV

By A. J. K. Moss.

London: TRADER PUBLISHING CO. LTD., Dorset House, Stamford Street, S.E.1. 1957. 11½ × 8½. 264 pp. Price 57s. 6d.

The presentation of information in this volume of the Servicing Guide series, prepared by *Motor Trader* and *British Automobiles Overseas*, differs from that of the preceding volumes in that it gives a wider range of data. The main change is that standard proprietary components are reviewed separately in detail, in accordance with the modern pattern of production, in which manufacturers are making greater use of standardized units. Proprietary diesel engines are also treated separately, in view of the number of different applications in which they are employed.

This volume is the first to contain only the later form of Service Data Sheet, in which all the major units are shown separated into component parts, or exploded. This type of illustration has been adopted because it is thought to represent the best means of conveying the maximum possible amount of information to the greatest number of readers at all levels of training. The 22 Service Data Sheets cover some 40 different models of cars and commercial vehicles, and information is given on three diesel engines. There are 18 articles on the servicing of components; these cover some 25 types, ranging from carburettors to automatic transmissions. The Data Sheets are arranged alphabetically, by names, into three groups, which are: cars, commercial vehicles and diesel engines, and components. At the beginning of each section is an indexed divider card, to facilitate reference. This is an invaluable reference work, particularly for those whose duties entail servicing many different makes and types of vehicle.

Car Driving as an Art

By S. C. H. Davis.

London: ILIFFE AND SONS LTD., Dorset House, Stamford Street, S.E.1. 1957. 8½ × 5½. 203 pp. Price 12s. 6d.

"Car Driving as an Art," which has now been thoroughly revised and enlarged, is now available in its second edition. It is, perhaps, outstanding in that it teaches road craft, the higher art of driving, as distinct from the elementary business of simply making the car start, stop, and keep on its course. Written by one who has made driving a lifetime's career and reached the very summit of his chosen calling, the book is intended for the advanced driver, as well as for those who wish to be initiated into the basic principles of the art.

Every aspect of handling a car is touched upon. There are sections dealing with operating the controls, making use of the

information provided by the instruments, road courtesy, written and unwritten traffic laws, handling a vehicle in all weathers and under all conditions, driving a high-performance sports car, maintenance and fault-finding, foreign touring, and so on.

The author has been driving cars since his infancy, not only on business and normal pleasure runs, but also in international rallies, in trials and on the race track. Few indeed can equal his vast experience, and it is doubtful if any can match his great enthusiasm. All through the book the theme is good and safe driving. At the end there is an appendix, discussing the causes of nearly 30 actual road accidents. Every driver, no matter how experienced, would benefit from a close study of this appendix. In every chapter, there are instances of those subtle tricks and refinements that distinguish the real driver, who takes a pride in his accomplishment, from the mere user of the highway. Drivers who read and thoroughly digest this work cannot fail to benefit no matter how experienced they are. Furthermore, they will derive much greater pleasure from their motoring.

Mechanical World Year Book, 1958.

Manchester: EMMOTT AND CO. LTD., 31 King Street West, 3. 1958. 6½ × 4½. 254 pp. Price 4s. 6d.

In this year's edition of the Mechanical World Year Book, an entirely new and up-to-date section on the subject of the die casting process has been included. The continual development of gas turbines has also been taken into account and new and revised matter has been added to the part dealing with this subject. Because of the advent of the practical application of nuclear energy, steam turbine design techniques are also advancing rapidly, so particular attention has been paid to this section. Minor revisions have been made in the remainder of the work.

Mechanical World Electrical Year Book, 1958.

Manchester: EMMOTT AND CO. LTD., 31 King Street West, 3. 1958. 6½ × 4½. 359 pp. Price 3s. 6d.

In the electrical field, development continues markedly in electronics. Therefore, this year's edition of the Electrical Year Book incorporates an enlarged section on electronic devices. In particular, additional information is given on amplifiers, time delay circuits, gas-filled valves, motor control, and oscillators.

PERFORMANCE PREDICTION

A Comparison of Various Methods of Estimating the Performance of a Vehicle

J. R. ELLIS, M.Sc. (Eng.) A.M.I.Mech.E.

ESTIMATES of the performance of a projected vehicle, in terms of time and distance required to reach a given speed, are of great interest to the large vehicle designer and prospective customer. A standard method of performance calculation would avoid such confusion as is likely to arise through the misquotation of design figures; and would engender confidence between the parties concerned.

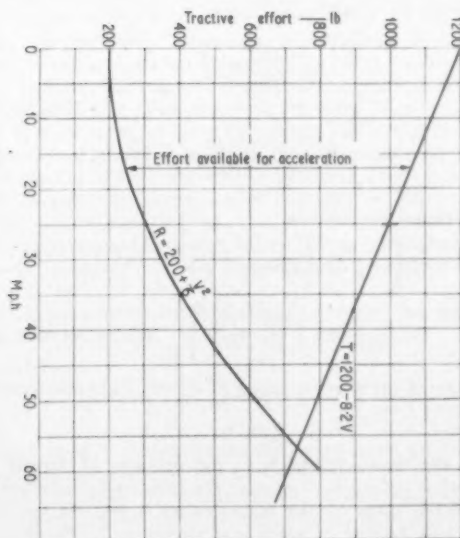
Graphical methods of obtaining the required performance estimate are usually employed. The basic information needed includes weight of vehicle, torque versus r.p.m. curves for the engine as installed in the vehicle, polar moments of inertia of wheels, engine flywheel and gearbox rotating parts, gear ratio and efficiencies, and resistance versus road speed curve for the complete vehicle. A fairly accurate assessment of most of these values is possible. The vehicle weight is the factor most likely to be adjusted from the initial estimate.

Using the tractive effort and vehicle resistance versus speed curves as a basis, several graphical methods have been suggested. The approach given by Dalby¹ is a direct integration from derived curves. This summing of small areas contained between a curve and the corresponding axis is a straight forward process with which every technician is familiar, since it is introduced at an early stage in his technical education. Unique methods, which need to demonstrate advantages such as accuracy and rapidity of solution to repay the time expended in obtaining a complete understanding of them, are given in articles that have appeared in *Automobile Engineer*^{2 and 3}.

The force required to accelerate the vehicle is given by:

$$P = \left[\frac{W}{g} + \frac{I_w}{r^2} + \frac{G^2}{r^2} \frac{1}{\eta} I_E \right] \times f + R \quad (1)$$

Fig. 1.



The term in brackets represents the apparent mass to be accelerated by the force P . This mass consists of the actual mass $\frac{W}{g}$, the sum of the polar moments of inertia of the road wheels divided by the square of the rolling radius, and a similar term for the engine divided also by the transmission efficiency η and the square of the gear ratio between the engine and road wheels, is the total resistance of the vehicle to motion.

The rolling radius may be taken as $r = R_0 (1 - \Delta/3)$, where R_0 is the unloaded tyre radius and Δ is the tyre deflection due to the axle load.

G will be large when low gear is engaged, but decreases in value as successive gear changes are made. The value of G in direct, or top, gear is that of the rear axle reduction ratio.

The substitution of the symbol M' as the apparent mass in the initial equation gives:

$$P - R = M'f \quad (2)$$

The acceleration may be written as:

$$f = \frac{dv}{dt} = \frac{ds}{dt} \frac{dv}{ds} \quad (3)$$

or:

$$f = V \frac{dv}{ds} \quad (4)$$

Use of these expressions leads to equations relating the time and distance to the speed change that occurs.

Substitution of equation (4) in equation (2) gives:

$$P - R = M'v \frac{dv}{ds} \quad (5)$$

or:

$$ds = \frac{M'V}{(P-R)} dv$$

whence:

$$s = \int_{V_1}^{V_2} \frac{M'}{(P-R)} V dv \quad (5)$$

Alternatively the use of the expression $f = \frac{dv}{dt}$ gives:

$$P - R = M' \frac{dv}{dt} \quad (6)$$

whence:

$$t = \int_{V_1}^{V_2} \frac{M'}{(P-R)} dv \quad (6)$$

Where V and t are known, as will be the case when equation (6) has been solved, another expression may be used to determine the distance in terms of time:

$$V = \frac{ds}{dt} \quad (7)$$

Therefore:

$$S = \int_{t_1}^{t_2} V dt \quad (7)$$

Use of either equations (5) and (6) or equations (6) and (7) will enable the distance and time intervals required for the speed to change from V_1 to V_2 to be evaluated.

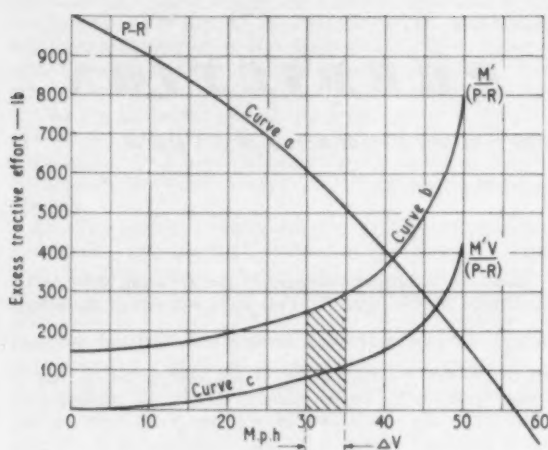


Fig. 2.

Selection of example

The accuracy and ease of manipulation of the various graphical methods can best be checked by obtaining the solution to a selected example by each method separately, and then comparing them to an analytical solution of this character, for which the numerical answer required may be obtained to any desired degree of accuracy. In order to provide an example that can be readily analysed, the tractive effort curve is taken as a straight line falling from 1,200 lb at 0 m.p.h. to 708 lb at 60 m.p.h., ($T = 1,200 - 8.2 V$). The total resistance to motion is assumed to be proportional to the square of the speed of the vehicle, and is 200 lb at 0 m.p.h. increasing to 800 lb at 60 m.p.h., ($R = 200 + \frac{V^2}{6}$). These

curves may be considered as satisfactory approximations to practical performance data. The maximum speed of the vehicle is 56.7 m.p.h., at which point the tractive effort and resistance curves coincide. Calculations are made of the time and distance required to increase speed from 20 m.p.h. to 50 m.p.h. in high gear. The selection of one gear only avoids the necessity of calculating the gear change times and is thought to be representative of actual operating conditions in this speed range. The limiting speed of 50 m.p.h. is selected because at this speed an appreciable tractive effort is still available for acceleration. As the upper speed condition approaches the maximum speed of the vehicle, the time and distance required increase rapidly and the need to allow for this in the graphical solutions may seriously affect the accuracy of the results over the middle speed range.

A value of 10 tons is taken as the actual weight of the hypothetical vehicle, this is increased by 7.5 per cent as an arbitrary allowance for the effect of the rotating masses of the wheels and engine. The total value of 10.75 tons is used as M' . In certain of the examples it is desirable to express the mass in slugs in order that time and distance may be obtained in units of seconds and feet respectively:

$$\begin{aligned} M' &= 10.75 \text{ tons} \\ &= 10.75 \times \frac{2240}{32.18} \text{ slug} \\ M' &= 749 \text{ slug} \end{aligned}$$

Analytical method

The effort available for acceleration of the vehicle may be obtained from Fig. 1, whence:

$$P - R = 1000 - 8.2V - \frac{V^2}{6} \text{ lb}$$

where the unit of V is m.p.h.

The equation of excess tractive effort with the velocity unit converted to ft/sec is:

$$P - R = 1,000 - 5.59V - 0.0776V^2$$

From the particulars given of the selected problem:

$$M' = 749 \text{ slug}$$

Substitution of the values of M' and $(P - R)$ in equation (6):

$$t = \int_{V_1}^{V_2} \frac{M'}{(P - R)} dv$$

$$\text{gives: } t = \int_{V_1}^{V_2} \frac{749}{(1,000 - 5.59V - 0.0776V^2)} dv \quad (8)$$

The solution of this differential equation is:

$$t = \left[40.5 \log_e \frac{155 + V}{83 - V} \right]_{V_1}^{V_2} \quad (9)$$

and the time required to accelerate from 20 m.p.h. ($\frac{88 \text{ ft/sec}}{3}$) to 50 m.p.h. ($\frac{5 \times 88 \text{ ft/sec}}{6}$) is obtained by substitution of

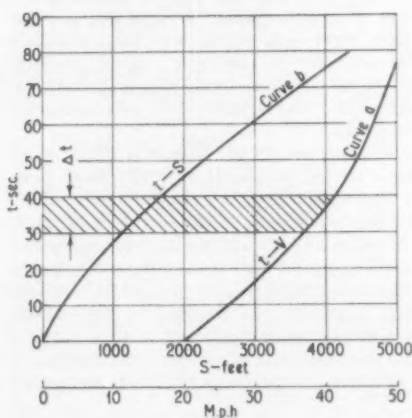


Fig. 3.

these limiting values of V_1 and V_2 respectively; whence:

$$t = 78.1 \text{ sec}$$

The distance travelled by the vehicle during acceleration between these speeds is obtained by substitution of the equation for excess tractive effort, and the apparent mass of the vehicle in equation (5).

$$\begin{aligned} S &= \int_{V_1}^{V_2} \frac{M' V}{(P - R)} dv \\ S &= \int_{V_1}^{V_2} \frac{749 V}{1,000 - 5.59V - 0.0776V^2} dv \quad (10) \end{aligned}$$

The solution required is:

$$\begin{aligned} S &= 9650 \left[-\frac{1}{2} \log_e \left\{ 119^2 - (V + 36)^2 \right\} - \right. \\ &\quad \left. \frac{36}{238} \log_e \left(\frac{155 + V}{83 - V} \right) \right]_{V_1}^{V_2} \quad (11) \end{aligned}$$

Insertion of the limiting values of V_1 and V_2 in this equation gives:

$$S = 4,390 \text{ ft}$$

An alternative approach to the problem of finding the distance travelled is to express the time-speed equation (9) in general terms by the additional of a suitable constant. From this general equation and equation (7), the distance

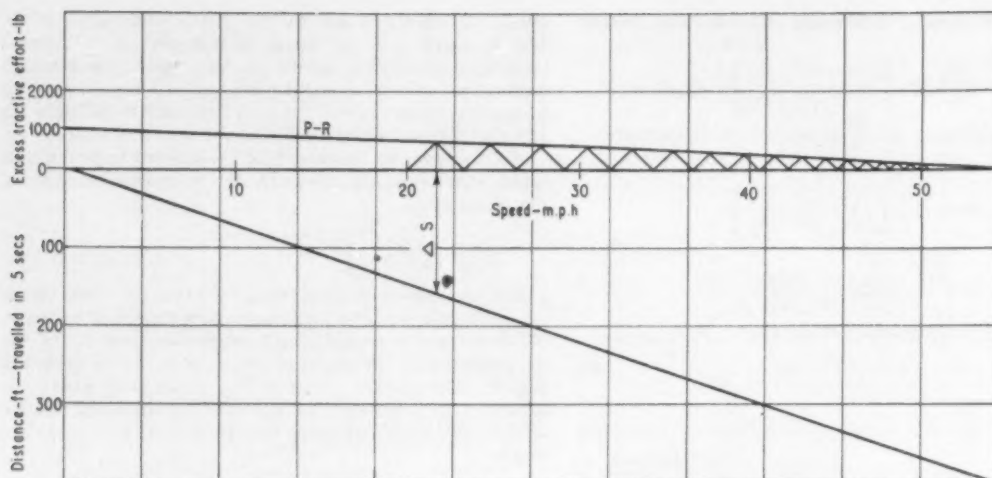


Fig. 6.

and $V \text{ ft/sec} = \frac{88}{60} V \text{ m.p.h.}$

Therefore: $\frac{(P-R)}{M'} \times \frac{32.2}{2240} = \frac{88}{60} \frac{dv}{dt}$

or $\frac{(P-R)}{102M'} = \frac{dv}{dt}$

Consider the excess tractive effort curve in Fig. 4 and the time-speed curve set out below it, using the same speed axis, and with the time axis vertically downward. The scales to which the values are plotted are:

Tractive effort scale (c) 100 lb = 1 inch
Time scale (m) 10 sec = 1 inch
Speed scale (a) 5 m.p.h. = 1 inch

At a speed V , the value of $(P-R)$ is A' , and the slope of the time-speed curve is XY , shown dotted. AA' is parallel to the speed axis meeting the tractive effort axis at A . PA is perpendicular to XY .

The tangent to the time speed curve at V may be taken as representing the curve over the small speed increment ΔV , where V is the mid-point of ΔV . The corresponding change in time is Δt .

The slope of the time-speed curve as drawn is then:

$$\frac{\Delta V \times m}{\Delta t \times a}$$

but this slope is also the slope of AP .

Therefore: $\frac{OA}{OP} = \frac{\Delta V \times m}{\Delta t \times a}$

When the increments of velocity and time are small:

$$\begin{aligned} \frac{\Delta V}{\Delta t} &\approx \frac{dv}{dt} \\ &= \frac{P-R}{102M'} \end{aligned}$$

On the tractive effort curve, Fig. 4, $(P-R)$ is the length OA multiplied by the scale factor c .

Hence: $\frac{dv}{dt} = \frac{OA \times a}{OP \times m}$
 $= \frac{OA \times c}{102M'}$

and $OP = 102M' \frac{a}{mc}$

The scale factors as used here describe the value per inch of each axis.

Therefore: $OP = \frac{102 \times 10.75 \times 5}{100 \times 10}$
 $OP = 5.48 \text{ in}$

The initial point on the curve is determined by setting the time for the start of the acceleration. In the present problem the time is zero at 20 m.p.h., and the initial point is 20 m.p.h.

on the speed axis.

The axes are set out as shown in Fig. 4, and the distance OP is marked on the extension of the speed axis. Increments of 5 m.p.h. are selected for dv . Starting at 20 m.p.h., the first speed increment gives 25 m.p.h., and the mean speed of the increment is 22.5 m.p.h. A line is drawn through the $(P-R)$ curve at this speed C' , cutting the axis at C . PC is drawn, the required slope of the time speed curve is perpendicular to this and is drawn to pass through the initial point on the curve. This line represents the time-speed curve from 20 to 25 m.p.h. A similar construction is applied to the 25-20 m.p.h. interval and the tangent obtained drawn through the point at which the first tangent cuts the 25 m.p.h. line. The process is repeated until the whole curve is obtained. The construction originally used to demonstrate the process and calculate the value of OP is that for the 35-40 m.p.h. interval.

A similar process may be used to find the distance required, but Koffman² suggests the use of the process of integration used in the first graphical method to obtain the distance-time curve. He gives a complete description and justification of the method.

Graphical method C

Here the problem is modified in a manner that claims to produce a simple, rapid and clear solution. To this end, the velocity scale is altered, and a long, low diagram produced.

The sketch Fig. 5 shows a portion of the excess tractive effort curve at some speed V , with speed increments $\Delta V/2$ on each side of the speed.

A triangle with base angles of 45 deg is drawn so that the apex is in contact with the excess tractive effort curve at v .

Then: $(P-R) = \frac{\Delta V}{2}$

Therefore: $\frac{(P-R)}{\Delta V} = \frac{1}{2}$

The equation of motion of the vehicle may be written:

$$(P-R) = M' \frac{dv}{dt}$$

and, when the speed increment is small, a finite value of ΔV may be substituted for dv . Δt is the corresponding time interval.

Therefore: $P-R = M' \frac{\Delta V}{\Delta t}$

Substitution of the known apparent mass of 10.75 tons and the inclusion of the value 88/60 of the conversion factor from m.p.h. to ft/sec gives:

$$P-R = \frac{10.75 \times 2240}{32.2} \times \frac{88}{60} \frac{\Delta V}{\Delta t}$$

when:
$$\frac{P-R}{\Delta V} = \frac{1098}{\Delta t}$$

The tractive effort is to be drawn so that 1,000 lb is represented by 1 inch, and it is decided that the performance will be obtained over intervals of 5 seconds ($\Delta t = 5$ sec.)

Referring again to the sketch Fig. 5, the velocity scale must be selected to satisfy this sketch. Let the speed scale be 1 m.p.h. = 1 inch. The actual distances on the sketch are:

$$\frac{OA}{OP} = \frac{(P-R)}{1000} \frac{a}{\Delta V}$$

Therefore:
$$\frac{P-R}{\Delta V} = \frac{1000}{2a}$$

In the other expression for $(P-R)/V$ the value of time increment selected is substituted for Δt .

$$\frac{P-R}{\Delta V} = \frac{1098}{5}$$

Equating these two expressions for $P-R/\Delta V$:

$$\frac{1,000}{2a} = \frac{1,098}{5}$$

Therefore:
$$a = \frac{5 \times 1,000}{2 \times 1,098} = 2.275 \text{ m.p.h./in}$$

or 2.275 m.p.h. = 1 in

The diagram, Fig. 6, is the tractive effort curve redrawn to the appropriate scales. The 5 second time interval selected gives rise to a variable speed increment, since the height of the 45 deg triangle is dependent on the value of the excess tractive curve at this speed.

COMPARISON OF RESULTS

Method	Acceleration from 20 to 50 m.p.h.	
	Time, sec	Distance, ft
Analytical	78.1	4,390
A	78.5	4,350
B	79	4,500
C	82	4,800

Starting from the speed of 20 m.p.h., a 45 deg triangle is drawn with the apex touching tractive effort curve; a series of such triangles is drawn so that the edge of the succeeding bases are in contact on the speed axis, as shown in Fig. 6. The length of the base of any triangle gives the change in speed during a 5 second interval for a mean speed corresponding to that speed given by the contact of the tractive effort line and the apex of the triangle. Since each triangle gives a 5 second time interval, the total elapsed time may be obtained by counting the number of such triangles. The result of this is shown as the t versus V curve of Fig. 7.

At 30 m.p.h., the vehicle covers 220 ft in 5 seconds, and at any other speed the distance covered in this time interval is in direct proportion. The distance of 220 ft is plotted directly below the 30 m.p.h. point on the speed axis, and a straight line is drawn from this point through the origin of the graph, producing a curve of distance travelled during a 5 second interval for any speed. At the mean speed of the interval, the distance travelled is given by the value of this curve under the apex of the triangular construction, and is marked s on the Fig. 6. A full description of this method is given in an article in *Automobile Engineer*.³

Conclusions

Each of the graphical methods was performed with equal care on a similar size of graph paper. The results are compared with the analytical solution in the Table. However, no attempt is made to quote the graphical answers to a greater accuracy than can normally be attained by use of a

slide rule. With the continual addition of slide rule values, the accuracy of the third figure is suspect.

The first graphical method, A, provides a fairly accurate answer, and has the advantage of requiring only the application of the first principles of graphical integration. This may be time saving in instances where the performance calculations are required at infrequent intervals. Method B is also reasonably accurate and apparently quite acceptable provided the method of calculating the pole distance and the geometrical construction are mastered. Method C required the calculation of a velocity scale, which, inevitably, cannot be plotted in a straight forward manner. In order to produce a diagram of reasonable length, it is necessary to use a tractive effort scale of 1,000 lb to the inch, in contrast with the methods A and B, where the scale is 100 lb to the inch. The use of 45 deg set-square to set off the mean speeds and distances as suggested³ was not found to be practicable, and these lines must be drawn separately in order to exert some control over the accuracy of the process.

Since the weight of a vehicle in the project stage is often modified, the use of tractive effort per ton curves is not recommended. When the weight is used as a factor to the graphical integration, the effect of weight changes on the performance can be determined rapidly.

Allowance must be made for the change in the effective inertia of the engine and flywheel in the various gears of a normal type of gearbox. Information is needed on the behaviour of the engine of a vehicle equipped with a hydrokinetic torque converter, as it is probable that the speed variation during acceleration of the vehicle is small, in which case neglecting the referred inertia of the engine and flywheel will cause a noticeable improvement in the calculated performance.

The effect of a gradient on the performance of a vehicle is to introduce a further resistance to motion, which is independent of speed and equal to that component of the vehicle weight that acts parallel to the gradient. This may be allowed for in all the graphical methods in a similar manner. A line is drawn parallel to the speed axis separated from it by the value of the gradient resistance. This line is then used as the base line for all further manipulation.

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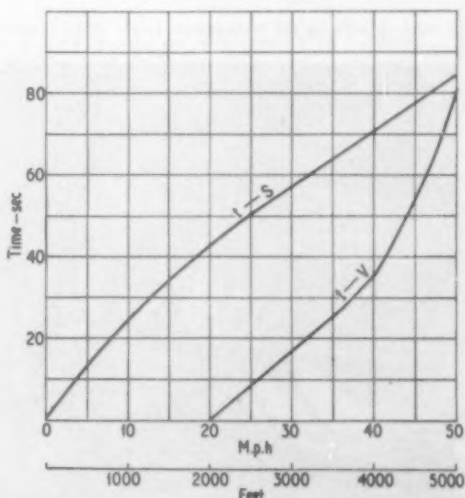


Fig. 7.

Plastics Suspension

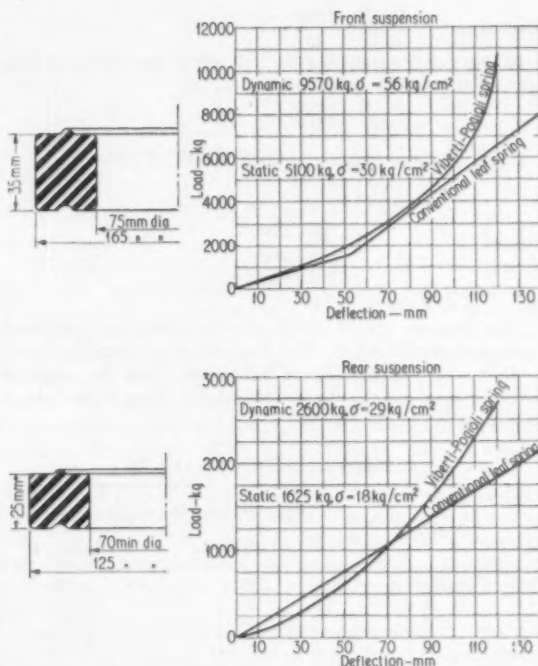
The New Viberti-Poglioli System, in Which Plastics Material is Used as the Elastic Element

ALTHOUGH semi-elliptic leaf spring arrangements currently employed on a majority of commercial vehicles are basically the same as those that were used on the horse-drawn carriage, it does not follow that designers are entirely satisfied with the performance of this type of spring. Among the disadvantages of the semi-elliptic spring is its large unsprung weight; varying damping characteristics, due to interleaf friction; the possibility of noise due to relative movement between the components of the spring; and the failure of this type of spring to isolate the sprung mass from high frequency vibrations and noise transmitted from the road.

Of course, much can be done to alleviate these shortcomings. For example, the consistency of the damping characteristics can be improved by the use of interleaving materials, lubricants, and by other devices to reduce interleaf friction to a minimum, and by incorporating, in addition, telescopic shock absorbers, the damping characteristics of which can be more readily controlled. These measures also help to reduce generation and transmission of vibration and noise. However, they do not obviate the difficulties arising because of the relatively high unsprung weight of the spring.

In recent years, as vehicle speeds and the demands for greater passenger comfort have increased, designers have been searching for alternative methods of suspension. Different materials, such as rubber, have been employed, and one of the latest developments is the introduction of air suspension. However, many of these new types of suspension suffer from the disadvantage that the cost of production is high. In most cases, this is because of the need to provide locating links to take thrust, drag and side loads. The incorporation of links has another disadvantage in that the relatively large number of pivot bearings is liable to lead to problems with regard to maintenance during service.

Now, following several years of research, Viberti S.p.A., of Turin, have developed a new type of suspension based on the use of resilient plastics rings in compression. The new sus-



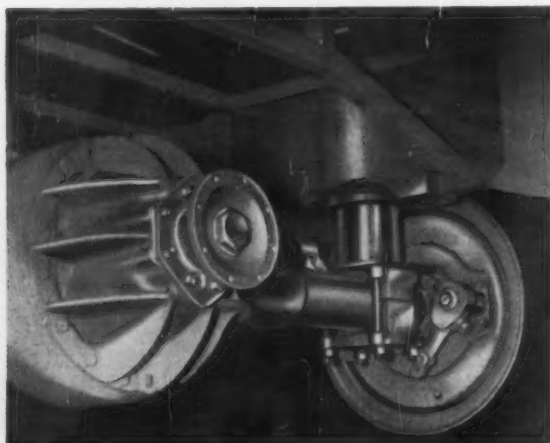
Comparison of the load-deflection characteristics of the Viberti-Poglioli spring and a conventional leaf spring. In this instance, a helper spring is used in conjunction with the leaf spring at the front and the simple semi-elliptic type layout is employed at the rear, for the comparison

pension spring assembly is of telescopic form, and one of its principal advantages is said to be extreme simplicity of construction. As can be seen from the accompanying illustrations, additional links are not required to locate the axle. The half-tone illustration shows a mock-up, in which an existing design of axle is used; the eye on top of the axle is incorporated for another application and is not needed with this type of suspension.

Viberti state that their new suspension has been tested over many thousands of miles on a number of experimental vehicles and they claim that its performance under all possible load and weather conditions has exceeded their most optimistic expectations. Apparently, no maintenance is necessary, largely because all the operating parts are hermetically sealed. It is claimed that the rate of wear is exceptionally low, and that another advantage of the system is silent operation. The light weight of each individual component is also a good feature.

From the diagrams showing the spring rate, it can be seen that the curves of load against deflection are of almost parabolic form. Consequently, the natural frequency does not vary greatly with the static load. This characteristic of the spring not only enables vehicles and trailers to run reasonably quietly and without sudden jerks on the trailer coupling, but also increases the life of the tyres. Because the spring rate,

A mock-up showing the arrangement of the Viberti-Poglioli suspension



risers with deflection, the roll resistance is better than with conventional springs, and therefore cornering characteristics are improved. Whereas a leaf spring breakage temporarily immobilizes the vehicle, failure of the spring element in the Viberti-Poglioli assembly does not. This is an important advantage to vehicle operators.

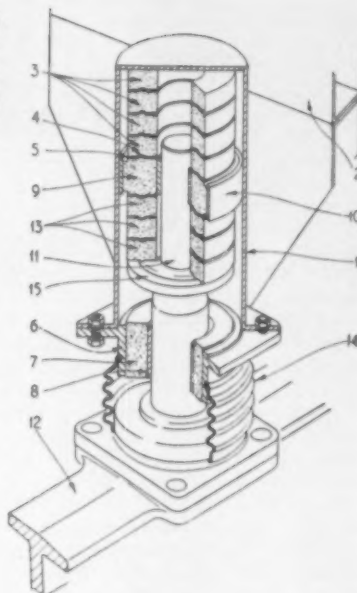
Construction

From the illustration, it can be seen that the suspension comprises the following components: a cylindrical container 1, secured to the chassis; a shaft 11, attached to the axle 12, and free to slide within the plastics rings contained in the cylinder. There are also two centring rings: the bottom one, 7, is fixed to the lower end of the cylinder, and the upper one, 9, is arranged as high as possible, having regard for the fact that in the rebound position the shaft 11 must remain supported by it.

The plastics rings 3 and 13 are the springing medium, designed to absorb the vertical dynamic loads. The number of plastics rings employed is such as to fill all the space between the upper end of the cylinder and the disc 15, which is rigidly attached to the shaft 11. When the suspension is in the rebound position, the disc 15 seats on the centring ring 7 and, in these circumstances, the rubber rings are compressively pre-loaded. Thus, there is no possibility of slack or play between the components supporting the vertical load, and noise during operation of the spring is obviated. Radial location of the rings is effected by circular pressed steel plates 5, with circular beads pressed in them. These plates are interposed between the plastics rings, each of which has a circular groove in one face and a rib on the other to register with the bead on the plate on each side of it.

Component 10 is a sleeve of self-lubricating material, surrounding the plastics ring 9. Thus, whenever the plastics rings 3 and 13 of the spring are compressed or extended, the ring and sleeve assembly 10 moves up or down in the cylinder. The extent of this movement is approximately half the relative displacement of the shaft 11. Centring ring 7 is carried in a flanged sleeve 6, which, as has already been stated, is securely fixed to the lower end of the cylinder 1. Both centring rings are bronze bushed, so that the shaft can slide freely in them.

A diagrammatic illustration of a sectioned spring assembly, showing the plastics rings in compression and the two guide rings for the central sliding component of the unit



The manufacturers state that lubrication of the spring assembly is unnecessary. A flexible gaiter 14 seals the unit and prevents foreign matter from entering and damaging the sliding components.

A special mixture, similar to that used for synthetic rubber, and containing buna and krylene as principal ingredients, is employed. The different properties required for the compression and centralizing rings are obtained by appropriate variations of the mixtures. The ingredients of the mixtures have been chosen so as to give the required hysteresis, or damping, characteristics. Elastic centring rings are needed, of course, to accommodate angular deflections of the axle owing to differential deflections of the wheels on each side.

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IMPACT EXTRUSION*

A Production Process of Great Potentialities

ALTHOUGH impact extrusion is a relatively new technique, it is used in the production of millions of parts per week. Impact extrusion, cold extrusion, cold forging and cold flow pressing all mean the same thing, that is, the conversion of metal blanks into shapes of another kind through plastic deformation by a fast application of pressure. Cold flow simply means that the blanks are normally fed at room temperature, but any temperature below the recrystallization zone of the particular material being worked would be suitable.

The process is basically simple. It has three main advantages, the most important being economy of material. In general, the volume of metal in the blank is the same as the volume of the finished part. Where trimming is necessary after the press operation only a very small percentage of metal is lost. Parts made by impact extrusion may also be stronger than those made by more conventional means, because the grain flow is related to the shape of the part by the plastic deformation that takes place in the press. Speed of production is the third main advantage. The production rate is often the number of the strokes of the press per minute.

The process has a very wide range, but at present the emphasis is chiefly on the extrusion of aluminium and other non-ferrous metals. Various problems and difficulties have restricted the use of the process for ferrous metals, but much research and development work, carried out chiefly in Germany and the United States of America, suggest that eventually the field for the extrusion of ferrous metals may well be wider than that occupied by non-ferrous extrusion. Even now large quantities of steel parts are being produced by impact extrusion.

Basically, impact extrusion consists in applying pressure as an impact on a metal blank in a suitably shaped die.

*From a paper presented by H. W. Byles of Wickman Ltd. to the Coventry Section of the Institution of Production Engineers.

The resulting plastic deformation of the metal produces the component. There are three variations of the principle. That most commonly used at present is backward extrusion, where the metal flows in the opposite direction to the movement of the punch. The second is forward extrusion, where the metal flows in the same direction as the punch. The third is a combination of the two, with extrusion taking place in both directions.

So far as the automobile industry is concerned, it is the application of the process to ferrous, rather than non-ferrous, metals that is of greatest interest. The technique has already been extensively applied to armament production in the U.S.A. and the degree of interest expressed points to a wide field of application in the automobile industries. Some of the components which seem particularly suited to this method of manufacture are various types of power cylinders, gudgeon pins, needle bearing cups, bushings, pistons, fuel injection pump components and special nuts.

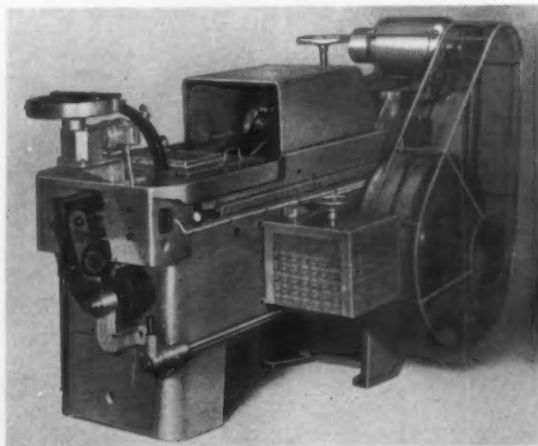
Most commercial steels can be cold worked, to a greater or lesser degree, in their fully annealed condition, but steels in the lower carbon range are usually employed because, in many instances, they show, after cold working, mechanical characteristics equivalent to those of some of the higher grade steels previously used.

In general, with ferrous materials the blanks are prepared from bar stock, and may be cropped, sawn or parted off. The cropping method gives the greatest economy of material, but has the disadvantage that the off-cuts are usually slightly distorted and are subject to some local work-hardening. Thus, the cropped blank usually requires a setting or sizing operation before extrusion. It might also be necessary for an annealing operation to be interposed, depending on the amount and extent of deformation in the sizing operation or any pre-forming that may have been carried out simultaneously. Annealing is often necessary

A selection of steel parts formed by impact extrusion



One of the range of Harlan toggle-action extrusion presses



when blanks are required that are thin in relation to their diameter, that is to say, when a piece of bar of smaller diameter is cropped off and then flattened to the required diameter and thickness. Sometimes blanks of this type can be produced automatically from bar stock in cold heading machines, although there are usually some limitations as to the maximum sizes obtainable in this way.

However, the better and more accurate the blank, the better the final result. This is particularly true of cylindrical components where a high degree of concentricity of the bore with the outer wall is required. In almost all cases the blanks must be in the fully annealed condition, and must be surface treated before extrusion to prevent metal-to-metal contact with the extrusion tools. The most commonly used surface treatment for steel is the application of a phosphate coating in conjunction with a lubricant. The importance of surface treatment for any material to be extruded cannot be overstressed. It can make all the difference between success and failure. Breakdown of the protective coating will cause seizure between the metal of the workpiece and that of the extrusion tools: the consequent resistance to metal flow will push up the pressure to a very dangerous extent, and will probably lead to tool failure.

For steel extrusion, the required pressures are, of course, generally of a much higher order than those for the non-ferrous group of metals. They depend upon various factors, including lubrication, extrusion speed, and the degree of reduction or change in the cross-sectional area of the component.

Extrusion speed is subject to speculation and there are conflicting opinions at present concerning this aspect of the technique. There is probably an optimum speed for every particular job. Suggested speeds vary widely from 10 in per second to 30 in per second. However, a lot of successful extrusion work has been, and is still being, carried out at much lower extrusion speeds, particularly on heavy hydraulic presses. The higher speeds are probably more applicable to parts such as plain cylinders of constant wall thickness.

Some authorities claim that for shallow, or relatively thin, parts, with changing cross section and increasing area, very slow pressing is preferable because of the increased frictional resistance. The degree of reduction in area which can be obtained in one operation will depend very largely upon the characteristics of the material. Whereas with pure aluminium it is possible to get reductions in the order of 90 per cent, this is not possible with steel, even in the most favourable conditions. The general consensus of expert opinion indicates that for the best and most consistent results the optimum lies somewhere between 55 and 70 per cent. Greater reductions have been achieved in experiments, but have not been maintained under production conditions, because in such cases the specific pressure builds up enormously and causes either premature failure or excessive wear on the tools.

Tooling is a vital factor in steel extrusion, and tool design "know-how" is important. Some parts may require several operations and the tool designer has to decide what can be best achieved at each stage. He has to take into consideration the metal flow and tool loading, coupled with the choice and heat-treatment of tool steel, and the question of ejecting the extruded parts. It is also essential that the tool designer should work in close collaboration with the component designer, since it is sometimes possible to effect slight modifications which, whilst in no way influencing the function of the product, can materially help in simplifying the extrusion operation.

With regard to the actual presses for the cold extrusion of steel, it may be said in general terms that almost any



This H.P.M. hydraulic extrusion press is fitted with an accumulator to give higher extrusion speeds

press will produce parts of a kind within its capacity. Nevertheless, the design of the press is of greater significance than is generally realized. The prime essentials are rigidity, power and some degree of speed control. Lateral rigidity is of equal importance to rigidity in the vertical plane. For example, with mechanical presses of the conventional over-crank type, good ram guides—which are essential—can be useless if the side frames flex under lateral thrust loads from the pitman when the metal slug is impacted at a point well up from the bottom of the stroke.

Presses originally designed for drawing, stamping and forming operations do not generally meet the requirements for cold flow pressing, because as a rule they lack the essential rigidity and stiffness in the bed ram and side members, and also are frequently underpowered. This is reflected in the indifferent results obtained, particularly as regards inaccuracy of product, poor tool life and low output rates.

Presses more specifically designed for this class of work are now becoming available. They are characterized by greater robustness and power. Some typical presses are shown in the accompanying illustrations. The horizontal toggle press illustrated is made by Maschinenfabrik Harlan in Germany. It is one of a range of 10 with capacities varying from 34 to 800 tons. For the pressures required to form heavy ferrous components, that is, in the order of about 1,000 lb/in², hydraulic presses are desirable. Typical of this group of machines are the presses designed by the H.P.M. Company, one is illustrated above, and now built in this country by Cravens of Sheffield.

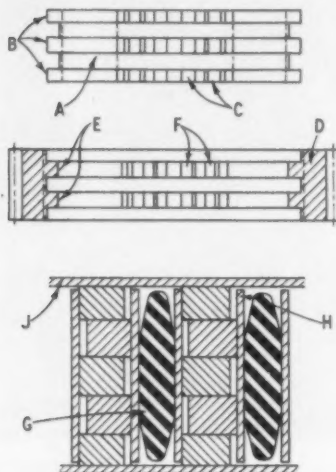
CURRENT PATENTS

A REVIEW OF RECENT AUTOMOBILE SPECIFICATIONS

Resiliently cushioned gears

Highly stressed gears, such as those used in vehicle drives, are formed of inter-engaging hub and rim components with interposed rubber masses of small bulk. The arrangement is claimed to absorb vibrations induced by irregular cutting of the gear teeth and to give quieter running.

Hub section A is provided on its outer



No. 774048

periphery with a plurality of annular grooves. The bearing lands B are cut transversely to form uniformly spaced projections C, the gaps being extended to a greater depth than the grooves. In the bore of the rim section D grooves are machined to receive lands B and lands E are gapped to provide complementary projections F. The two sections are engaged coaxially and then radially moved half the pitch of the projections to bring the gaps into axial alignment.

In the gaps are inserted pads G of natural or synthetic rubber. Preferably metal blades H are fitted to ensure a better distribution of stresses. Annular plates J enclose and protect the pads G. Patent No. 774048. P. R. Magnien and "L'Engrenage" (France)

Final drive arrangement

External thrust on either one of the half-shafts of this rear axle drive is transmitted to the other and supported by a tapered-roller bearing. The arrangement is claimed to be more rigid than, yet no heavier than, a similar unit of conventional design.

Crown wheel A is bolted to the differential cage B, divided in a plane containing the axis of the input shaft carrying the bevel pinion C. In the cage is a pair of coaxial bevel sun wheels D, each having a splined shaft portion engaged and secured in a flanged sleeve E. These sleeves are journaled in perforated cast iron bushes F, which are themselves freely journaled in

the bore of the crown wheel and the bore of the differential cage respectively. On the sun wheels are spigot portions G, capable of abutting one against the other and also serving to locate the spider carrying the bevel planet pinions H.

The crown wheel and differential assembly is mounted in tapered-roller bearings housed in aligned bores in the main, undivided casing and located axially by the oil seal housings. Axial adjustment of the assembly is by means of the shims at the joint faces. Any external thrust from a half-shaft is transferred through its associated sleeve E, sun wheel D, and the spigots G to the other sun wheel. Thence it is transmitted through the flange of the respective bush F and the hub of the differential assembly to the tapered-roller housing.

Forming a detachable sub-assembly, the intake shaft is mounted in tapered-roller bearings in a pinion housing. Pre-loading of the bearings is determined by shims between the spacer and one of the bearings and axial adjustment of the pinion relative to the crown wheel is by shims between the pinion housing flange and the main casing. The propeller-shaft coupling is slidably splined on the input shaft. A rear cover J closing the main casing may be provided with lugs or brackets for the attachment of the unit to the vehicle framing. Patent No. 770680. David Brown and Sons (Huddersfield) Ltd.

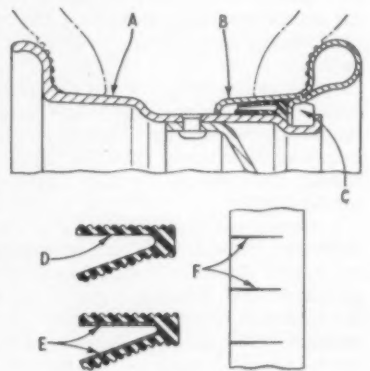
Sealing divided wheel rims

If a tubeless tyre is to be fitted to a conventional divided rim for heavy commercial vehicles it is necessary to seal the rim assembly since, in conjunction with the tyre casing, it must form a closed, fluid-tight chamber. The invention provides a means of sealing the rim that does not require extensive alteration to the assembly.

The rim comprises a base section A, an axially movable ring member B and a

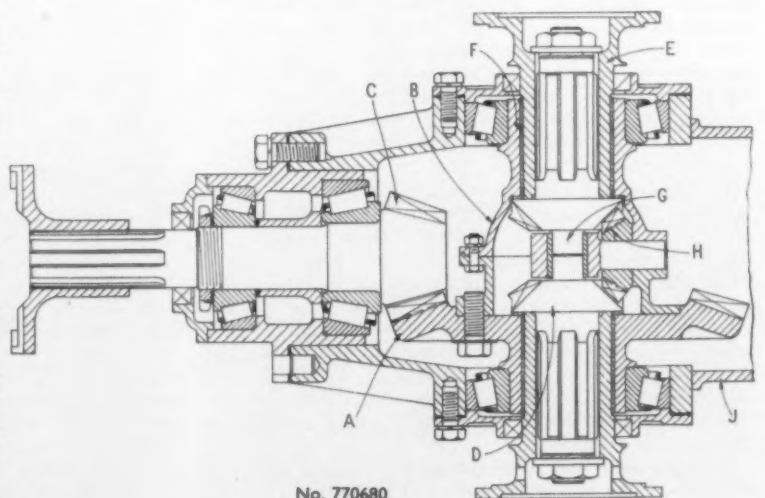
split locking ring C. To effect a seal between parts A and B an annular member D of rubber is fitted. In section this member is of bifurcate shape, with the legs directed towards the clearance gap between parts A and B. Preferably, the outer surfaces of the legs are formed with circumferential ridges, so that the area of contact with the rim parts is reduced and consequently the sealing pressure of engagement of the ridges is greater than the pressure in the interior of the tyre.

To ensure initial contact on assembly, the sealing member is moulded with the legs diverging at 20 deg, but this angle is



No. 773690

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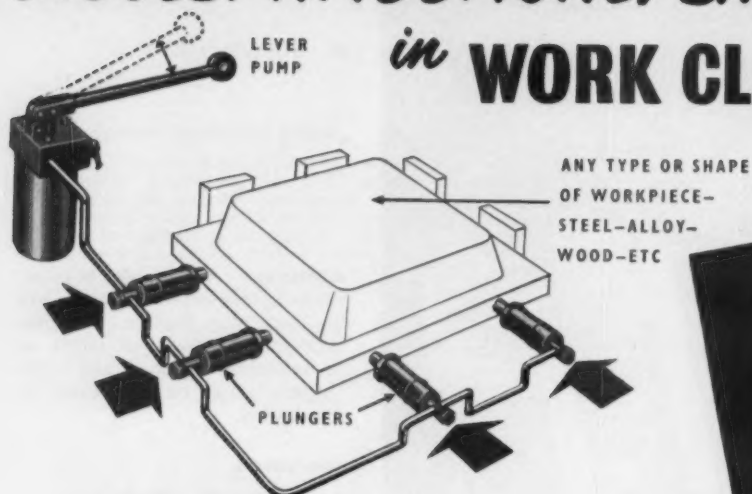
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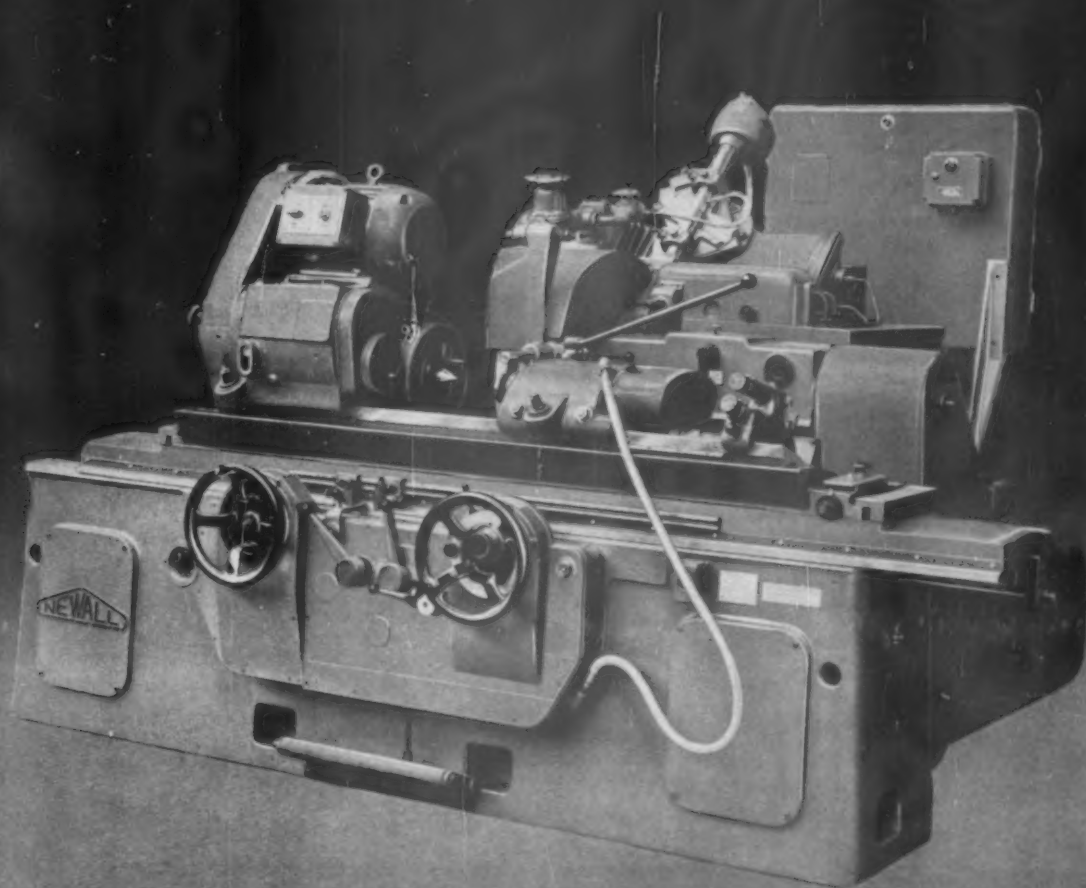
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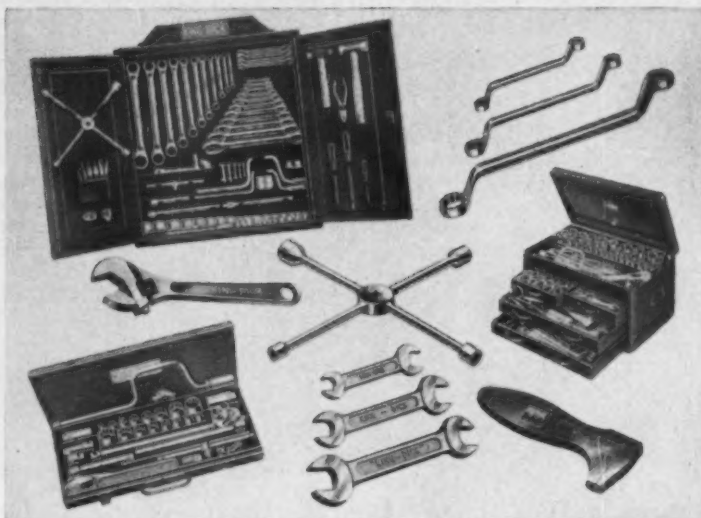
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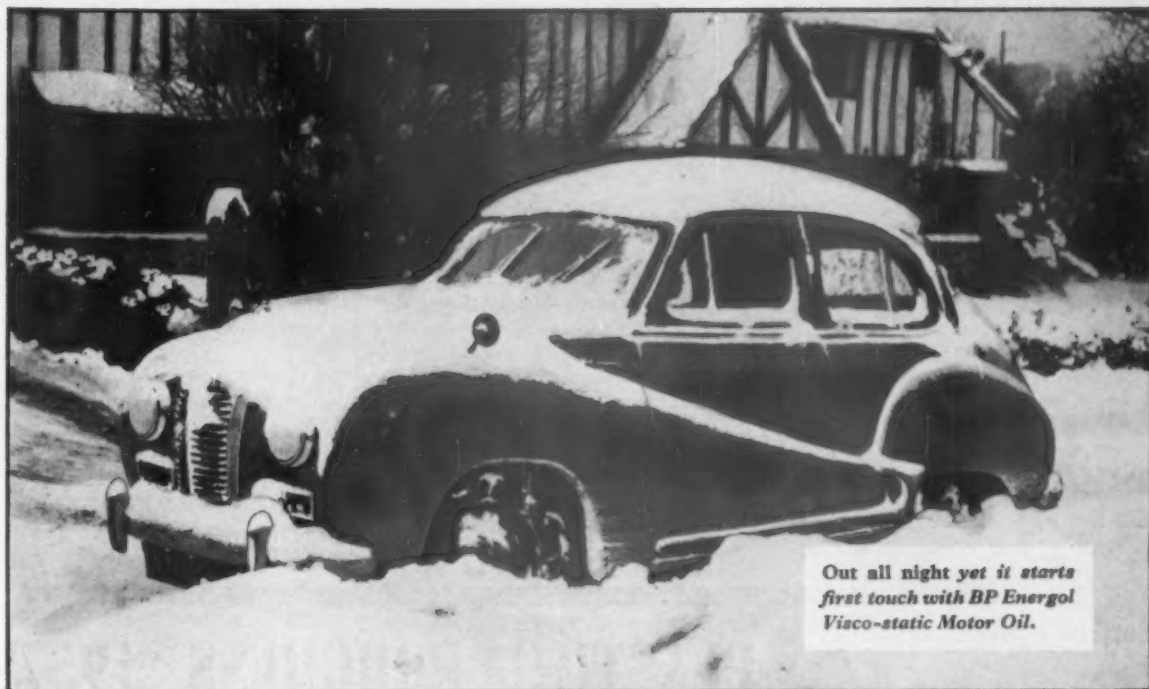


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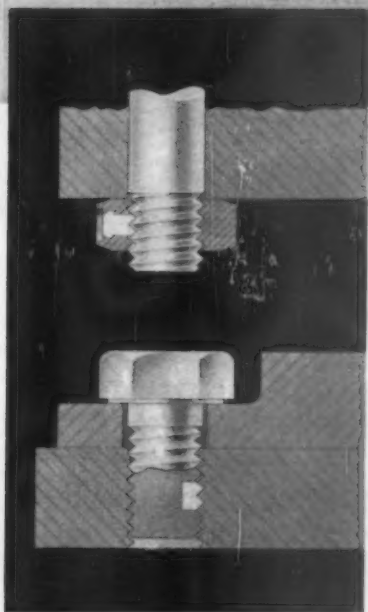
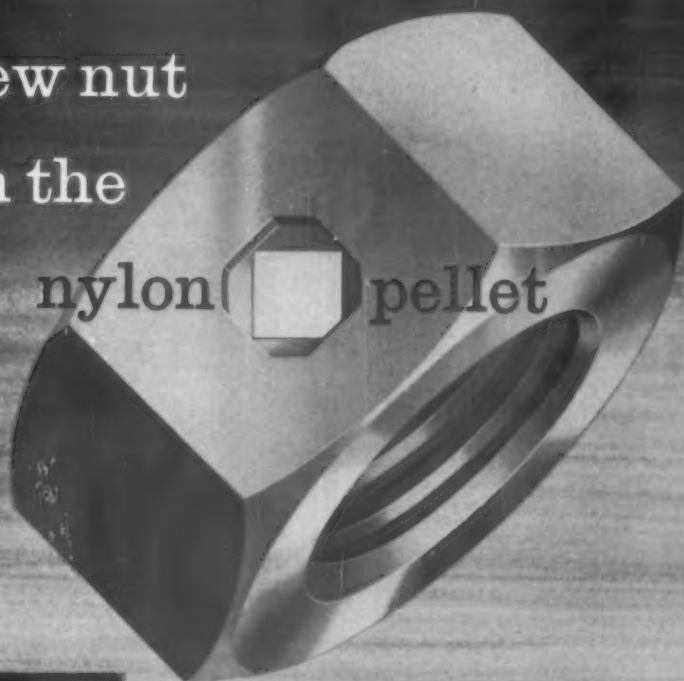
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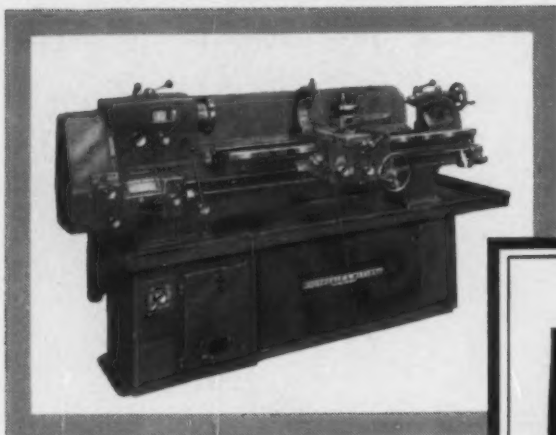
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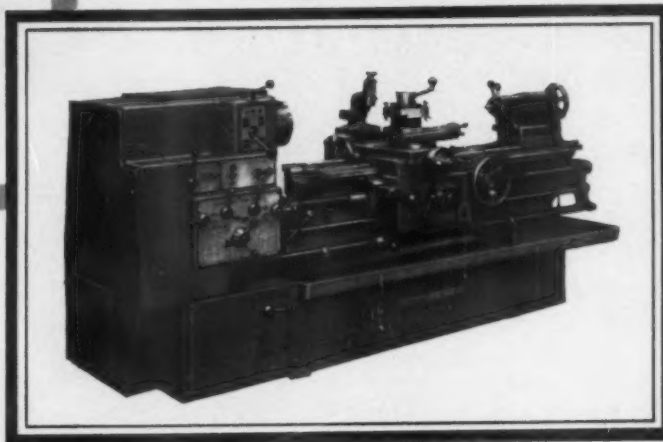
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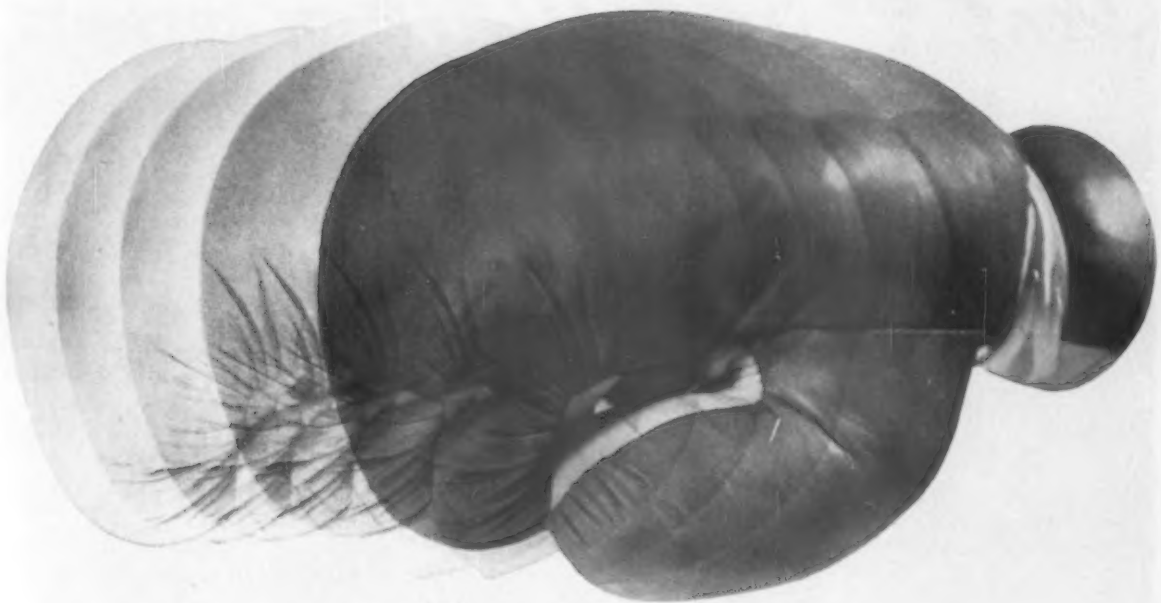
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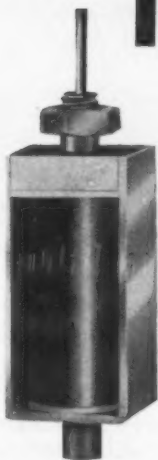
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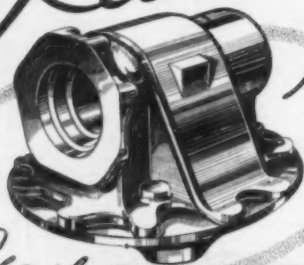


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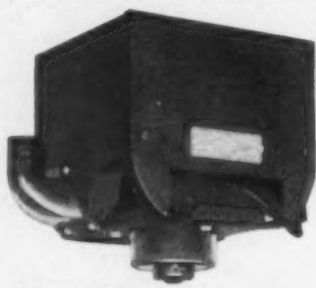
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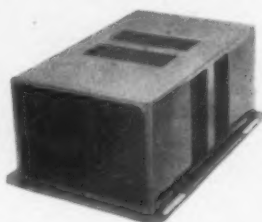
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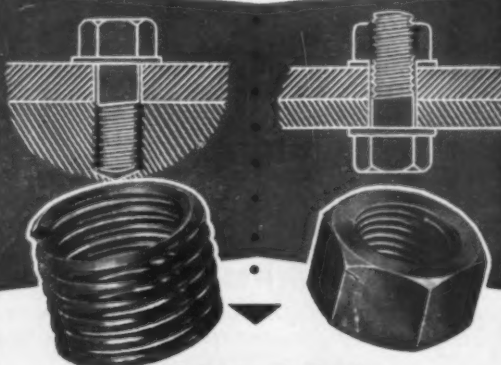
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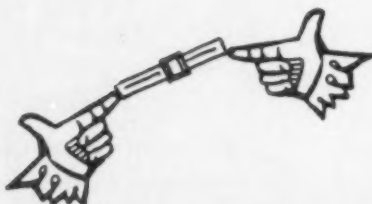
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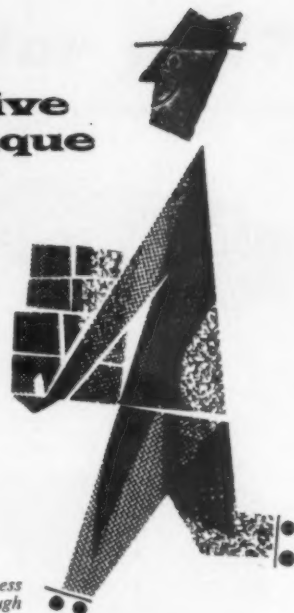
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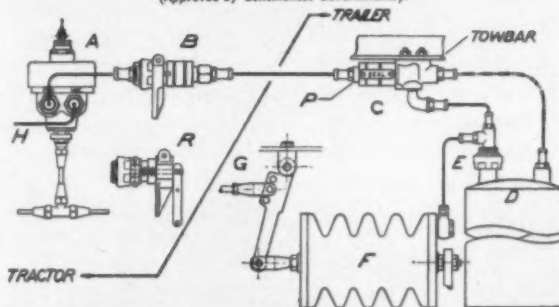
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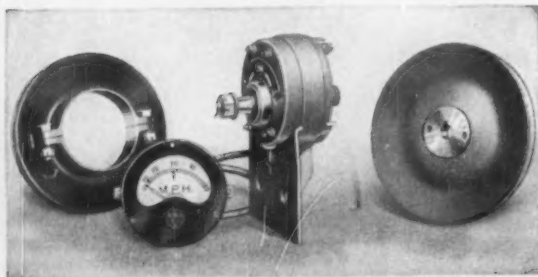
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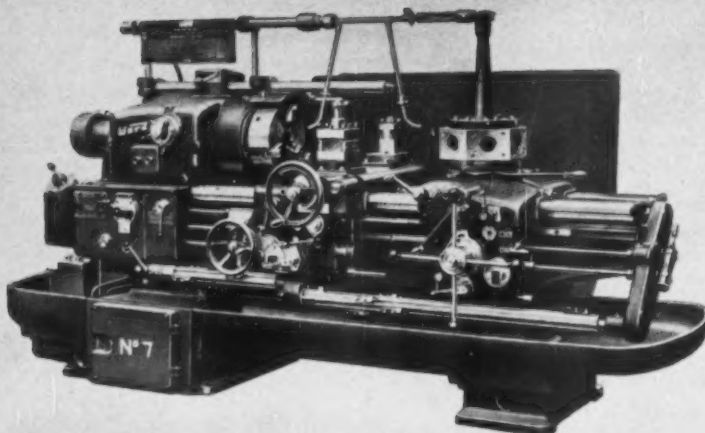
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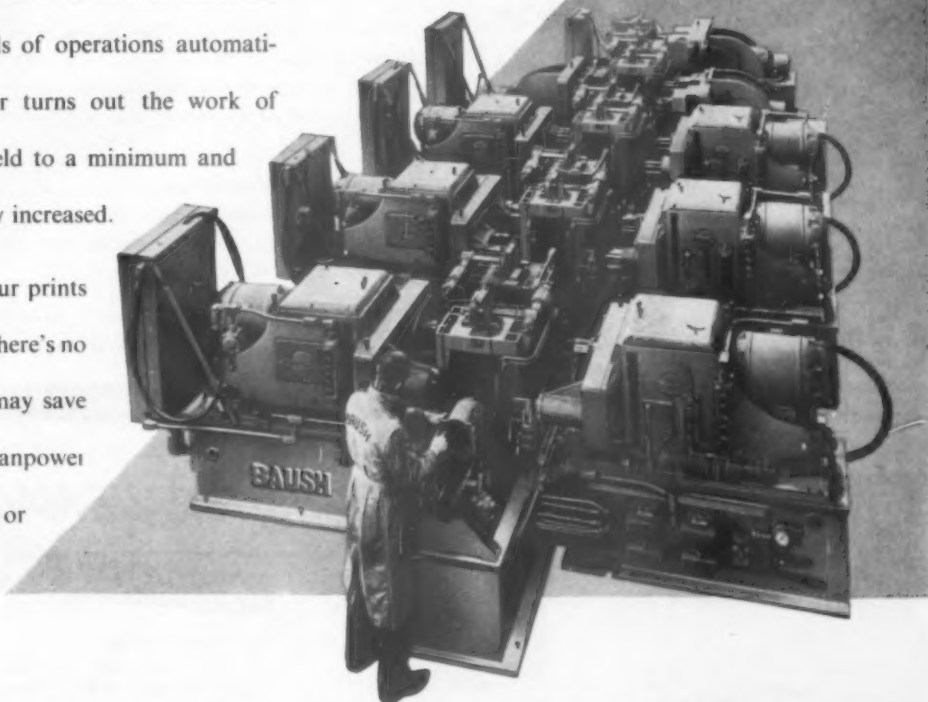
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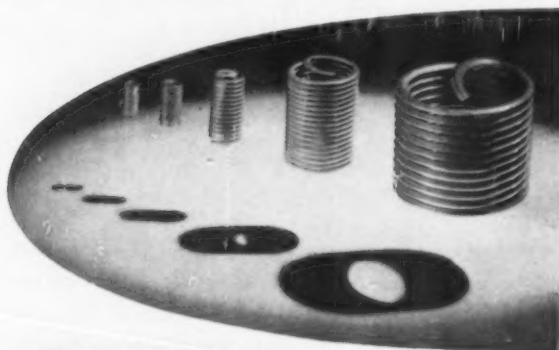
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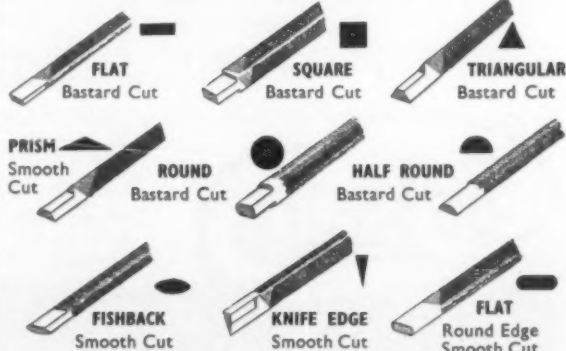
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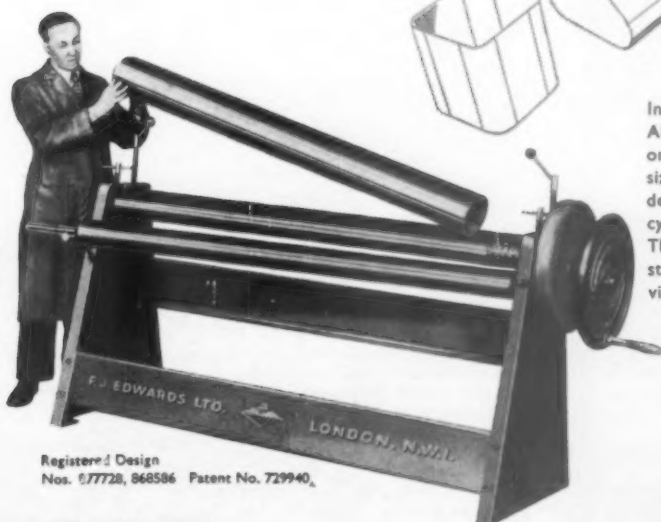
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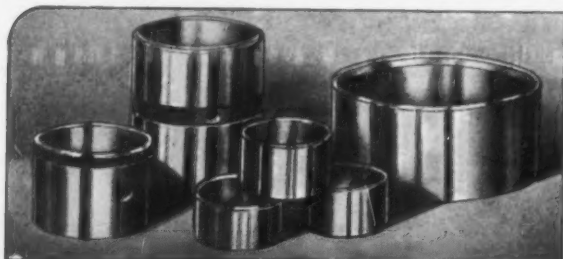
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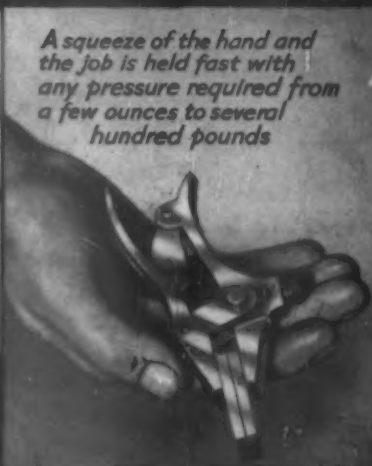
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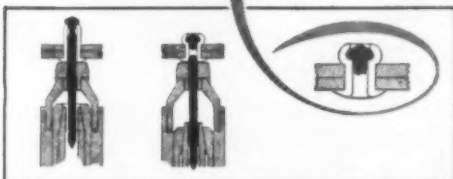
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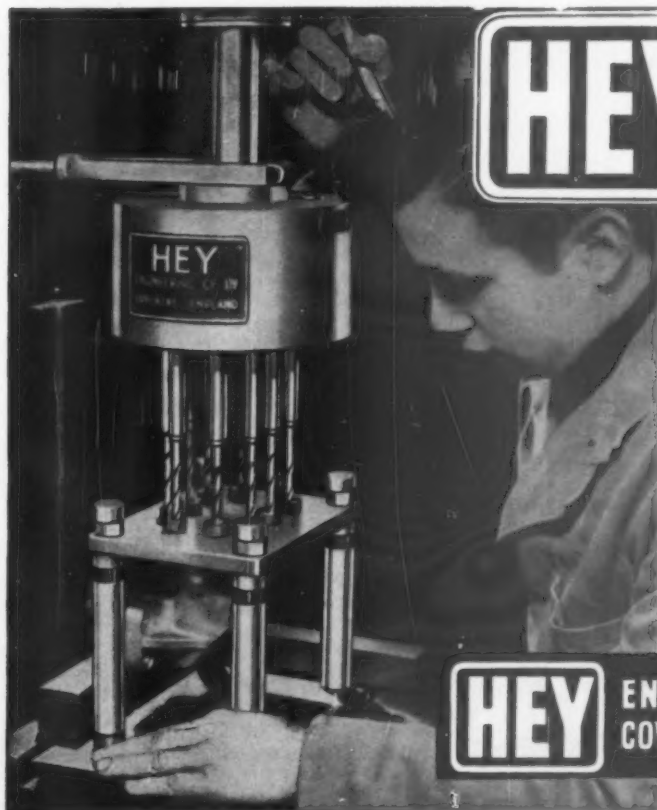
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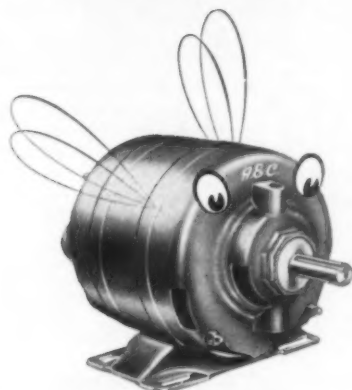
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